NORDIC

ROAD AND TRANSPORT RESEARCH | NO.3 | 2006

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News from

VTI, Sweden

VTI is an independent, internationally established research institute which is engaged in the transport sector. Our work covers all modes, and our core competence is in the fields of safety, economy, environment, traffic and transport analysis, public transport, behaviour and the man-vehicle-transport system interaction, and in road design, operation and maintenance. VTI is a world leader in several areas, for instance in simulator technology.

Danish Road Directorate (DRD) Danish Road Institute (DRI)

The Road Directorate, which is a part of The Ministry of Transport & Energy, Denmark, is responsible for development and management of the national highways and for servicing and facilitating traffic on the network. As part of this responsibility, the Directorate conducts R&D, the aim of which is to contribute to efficient road management and to the safe use of the network. The materials research component is carried out by the Danish Road Institute.

Technical Research Centre of Finland (VTT),

VTT Technical Research Centre of Finland is a contract research organisation with a staff of 2,800. In this joint publication, the VTT expertise areas cover research and development of transportation, logistics and road structures. The work is carried out in five research groups employing a staff of 60.

Icelandic Road Administration (ICERA)

The ICERA's mission is to provide the Icelandic society with a road system in accordance with its needs and to provide a service with the aim of smooth and safe traffic. The number of employees is about 340. Applied research and development and to some extent also basic research concerning road construction, maintenance, traffic and safety is performed or directed by the ICERA. Development division is responsible for road research in Iceland.

Norwegian Public Roads Administration (NPRA)

The Norwegian Public Roads Administration is one of the administrative agencies under the Ministry of Transport and Communications in Norway. The NPRA is responsible for the development and management of public roads and road traffic, as well as the Vehicle Department. This responsibility includes research and development of all areas related to road transport and the implementation of R&D results.

Institute of Transport Economics (TØI), Norway

The Institute of Transport Economics is the national institution for transport research and development in Norway. The main objectives of the Institute are to carry out applied research and promote the application and use of results through consultative assistance to public authorities, the transport industry and others. The Institute is an independent research foundation employing about one hundred persons.

Editorial notes

Nordic Road & Transport Research is a joint publication of six public road and transport research organisations in the Nordic countries, Denmark, Finland, Iceland, Norway, and Sweden. The main objective of the publication is to disseminate research results and news from the institutions, especially to researchers and decision makers. Each institution is responsible for the selection and presentation of the material from its own scope of activities.

Nordic Road & Transport Research is published three times a year. It is regularly sent out, free of charge, to recipients selected by the six joint publishers. Free sample copies are also sent out on special request.

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EU project awarded prestigious prize

Swedish Road and Transport Research Institute, VTI, has participated, as one of nine partners, in the EU project IERD (Integration of the Measurement of Energy Usage into Road Design). This project has recently been awarded the Bentley BE Award of Excellence in the category "Civil New Technology Adoption".

The prize is awarded to projects that improve infrastructure. A computer based method/software called Joulesave was developed within the project. Using Joulesave it is possible to make parallel estimates of energy use for both the construction and the use of the road for various designs and alignments over the terrain.

– Greater energy efficiency in road traffic is accompanied by other favourable effects such as lower emissions and reduced vehicle costs. Since Joulesave is based on an earlier well established method, it provides good opportunities for achieving the potential gains, says Ulf Hammarström, research leader at VTI.

The inputs of VTI comprised the development of a special energy version of the VETO model, a user friendly interface for inputting data, and the associated manual. The VETO model forms the basis for many of the relationships in the Swedish emission models for road traffic which are today used for planning and monitoring. The documentation comprises, inter alia, analysis of problems with a summary of the design assumptions, data concerning driving behaviour associated with road design, and various analyses.

PHOTOS.COM

The project brought together experts in road design, energy use, geotechnics and IT. Five of the countries that took part in the project also contributed detailed information on road projects in their countries.

ICERA's research conference 2006

On the 3rd of November 2006, the development division of ICERA held its research conference. In the Icelandic Road Act it is stated that 1per cent of the ICERA's budget, which is by law a specific part of fuel tax income, is granted to research and development. This research conference is now a yearly event, the first was held in 2001, so this was the fifth time. In these conferences a little part of the research and development projects supported by ICERA can be presented. This is an Icelandic conference and all the presentations are in Icelandic. This year there were 21 lectures mostly about projects carried out in 2005. These conferences have gathered over 120 persons from Iceland each time and this time there were 135 participants.

TØI joins CIENS

Since October 2006 TØI has been part of the Oslo Centre for Interdisciplinary Environmental and Social Research – CIENS for short. Being located next to the main campus of the University of Oslo, the centre consists of eight independent research institutes with a combined staff of about 500 persons.

The main idea of CIENS is to encourage integration along two essential dimensions: between basic and applied research, and between natural and social science and their related disciplines. The aim of CIENS is to help solve the substantial and complex challenges arising in the interface between environment, business, and politics.

PHOTO: ARE WORMNES.

HRH The Crown Prince of Norway opened the new CIENS research centre.

The new CIENS building, which was officially opened by HRH The Crown Prince in November, is characterized by carefully considered, innovative solutions. Effective use of geothermal heating, preheating of hot water with solar energy, solar panels for electricity production, and management of water runoff from the roof and other water-tight surfaces are only some of the solutions that have been taken into use.

Visit www.ciens.no.

Malaysian transport minister visits VTI

The Malaysian transport minister Dato' Sri Chan Kong Choy, together with a delegation of around 20, visited Sweden and VTI in September. The Malaysian Government has decided to set up a "national institute for traffic safety", and the aim of the visit to Sweden was to study Swedish traffic safety developments which, internationally, are regarded as a model of good practice. The Malaysian delegation wanted to learn about Swedish experiences, and use them as a basis in formulating their own traffic safety programme.

They found it of special interest to learn about VTI and its research activities, and the importance of research in developing a safe transport system. During an intensive day with Director General Urban Karlström and staff, the delegation listened to a number of presentations on crash safety, road design, road user behaviour and road properties from a traffic safety perspective. The delegation also had the opportunity to see how the heavy equipment of VTI, such as the road simulators and the crash test tracks, are used in practice. The minister and delegation showed great interest in what they saw, and surely left Sweden with many useful experiences that can be used in setting up their own research institute.

PHOTO: VTI

Prize for Best Master's Thesis

On October 25, 2006 about 500 participants from industry and the Norwegian University of Science and Technology in Trondheim (NTNU) were present when the prize for best master's thesis in the area of construction and environment was handed out. The winner was Per Otto Aursand who is recently employed as graduate engineer in the Norwegian Public Roads Administration (NPRA).

PHOTO: BAARD NONSTAD, NPRA

The photo shows a happy Per Otto Aursand together with Kjell S. Bjørvik, Assistant Director of Roads (left), and Tore Hoven, head of Department of Technology in Trondheim (to the right). A proud supervisor, Professor Ivar Horvli of NTNU, also showed up at NPRA's exhibition during The Day of Construction and Environment in Trondheim.

Every year at NTNU a prize for best master's thesis is handed out to a student of construction and environment. A monetary prize of 10,000 NOK and a diploma for excellence, is handed out to the student who delivers the best master's thesis during the latest year. The competition among the approximately 150 students is tough.

This year the prize was won by Per Otto Aursand for his master's thesis on "Evaluation of Frost Characteristics of Crushed Concrete". In his master's thesis the candidate has, both theoretically and through tests, investigated the utilisation of crushed, old concrete as base material for roads. The master's thesis work is carried out as part of the Norwegian Recycling R&D project at Department of Technology, NPRA.

After completing his master's degree studies last spring, Per Otto Aursand has chosen to continue to work with road technology. He is now an employee of NPRA, Northern Region. He was employed according to the newly established Program for Recruitment within NPRA.

The “Silvia Project” is Completed – The “Inquest Project” Disseminates the Results!

In August 2002, the European SILVIA project was started. The title of the project is “Sustainable Road Surfaces for Traffic Noise Control”. One of the objectives of SILVIA was to evaluate and specify road construction and maintenance techniques that would achieve satisfactory durability of acoustic performances of noise reducing road surfaces while complying with other requirements of sustainability i.e., safety, pollution, fuel consumption, structural durability and costs. The SILVIA project was partly financed by EU and partly by national sources. Fifteen partners from research institutes, universities, public institutions and private companies from eleven European countries including Denmark, Norway and Sweden were working together in this comprehensive three year project.

This project is now completed and a final report and Guidance Manual can be found on http://www.trl.co.uk/silvia/.

The work is considered of such importance that a two year project, INQUEST, has been started by EU in July 2006 with the sole purpose of disseminating the information and results obtained during the SILVIA project to those countries that did not participate in the original project. This dissemination work is being carried out by the Forum of European National Highway Research Laboratories, FEHRL, members, the Danish Road Institute and BRRC, the Belgian Road Resesearch Centre.

Unique Travel Planner Developed

VTT has in collaboration with institutes from Denmark, Norway, Sweden and Germany developed a Travel Planner, which helps to plan combined passenger ship and vehicle trips between Finland, Scandinavia and Germany. The service contains information about the 30 biggest passenger ship lines in the Baltic Sea and digital maps of road transport between the destinations and ports. The Travel Planner is able to define several route plans from origin to destination, e.g. from Helsinki to Hamburg.

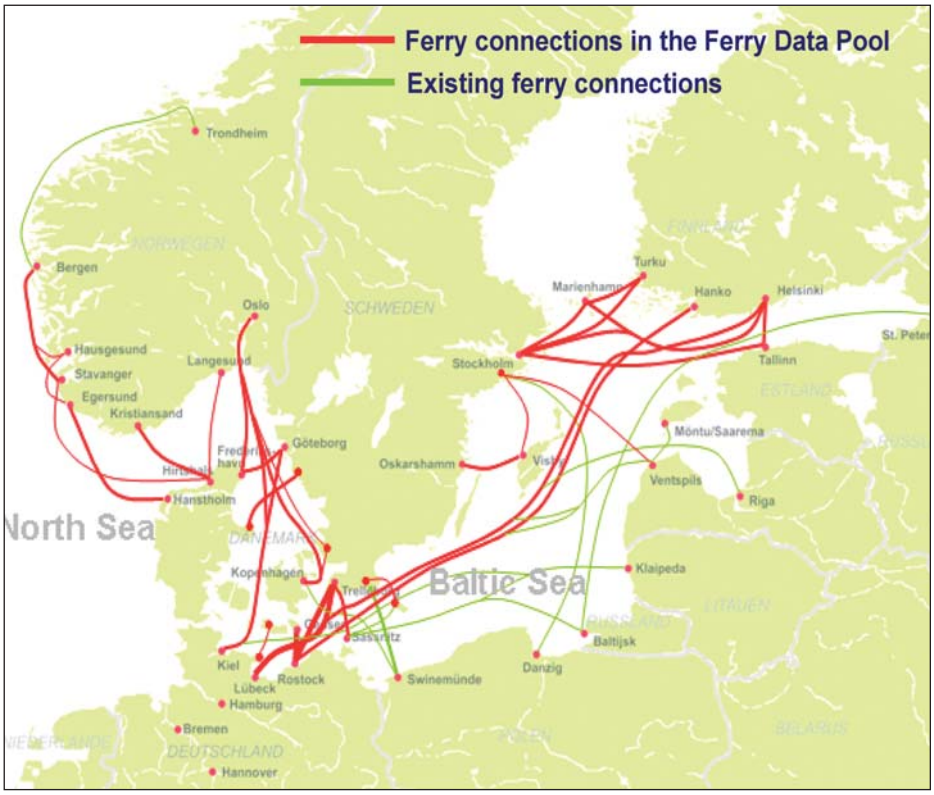
The Baltic Sea passenger ships’ routes, timetables and attribute data have for the first time been collected into a common Data Pool specially adapted for the use of commercial service providers. The Data Pool forms the basis of the Travel Planner of passenger ship lines and vehicle transport and is open to all users.

The Travel Planner offers a comprehensive and versatile package of information about travelling alternatives over the Baltic Sea. The Data Pool information, together with digital maps from the road network, can be utilized for planning combined vehicle and passenger ship trips between Finland, the Scandinavian countries and Germany. The Data Pool also contains information about passenger ship companies and links to their booking systems.

In practice the service is used by entering e.g. “Helsinki, Eteläesplanadi 16” in the “From” column and "Hannover, Hindenburgstrasse 2" in the “To” column. A routing algorithm then defines several route plans from origin to destination combining the route, passenger ships and bridging road transport connections. It is also possible to simply write “Helsinki” in the “From” column and “Hamburg” in the “To” column. The service brings up a map of the selected route and detailed driving instructions.

The service is implemented in co-operation between the Euro regional VIKING project and the road authorities and ministries in Denmark, Finland, Germany, Norway and Sweden. WM-data and Hacon were responsible for the technical implementation of the Data Pool and the Travel Planner.

The Travel Planner can be accessed through the VIKING travel information service on http://www.travel-and-transport.com or directly through http://www.ferry-routing.com. The service is planned to be operated with public funding until the end of 2008.



Wear Particles Can Be Studied in a ”Clean” Environment

The VTI road simulator was constructed as early as 1943. The aim then was to use it for testing gravel roads, cobblestones and road constructions. Work later focused on studies of wear of road surfacings and tyres. Today, 60 years later, the simulator is still extensively used for tests and research. The equipment now has a new field of use – the generation of particles.

We are all aware of the problems caused by respirable particles. A large proportion of these particles are wear particles from road surfacings and tyres. To carry out research on this, it is necessary to study the particles separately without the admixture of particles from exhaust gases and other sources. In the VTI road simulator it is possible to generate these “pure” particles since the equipment is housed in a clean indoor environment and is driven by electric motors. Since 2003, the simulator has been used to generate particles for the study of particle characteristics and the toxic properties of particles. Using the simulator, it is possible to generate wear particles and to study how the quantity of particles can be influenced by the choice of tyres and road surfacings.

PHOTO: MAGDALENA GREEN

The road simulator comprises a 16 m long and 0.5 m wide circular track which can be paved with the road surfacing to be tested. On the six wheels carried by axles mounted on a central vertical axis, different types of tyres can be fitted. Four of the axles are driven by electric motors. During a test the wheels are lowered onto the track at the required axle pressure, and the wheels impart a rotary motion to the simulator track. Speed can be varied steplessly up to 70 km/h. At speeds above 50 km/h an eccentric movement can be engaged to ensure that the wheels do not drive along the same track but move over almost the whole width of the track. In the room where the simulator is installed, the temperature can be regulated down to below 0°C to make the research environment even more flexible.

Thousands of investigations have been made since the simulator was put into service, and they have shown, for instance, how stone size, binder, speed and moisture influence the wear of surfacings. During the 1990s a new laser instrument was developed which enables measurement of the accelerated tests to be made with even higher precision. Studies in the road simulator have been made in close cooperation with the Swedish Road Administration, tyre manufacturers, contractors and others.

In spite of its age, this equipment still has three important fields of use – the generation of “pure” wear particles, the study of the abrasion resistance and environment friendliness of different types of road surfacings and tyres.

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Tunnels Between the Continents?

Some years ago a work group within the International Tunnelling Committee (ITA) started up with a visionary project: The Trans Atlantic Tunnel Concept. The work group meant that the old idea of connecting America and Europe with a tunnel may be worth looking at again. The author Håvard Østlid, recently retired from the NPRA, has worked with this issue for several years.

In the future, mass transport with lowest energy consumption will be very important. In this article you will see illustrations of what may be possible in future and some of the major problems and questions are briefly discussed. Very briefly! The starting point is the following:

Three tunnels positioned at 200–300 meters depth, MAGLEV trains travelling at about 1 000 km/h transporting goods the first few years. Later, when more experience is gathered with the system, transport of passengers as well.

What sort of problems would we meet?

- Getting acceptance for the idea and not be classified as pure science fiction
- Attracting competent persons to work on a pre feasibility study on a not too difficult first project
- Finding funds sufficient for doing a realistic study
- Crossing oceans means negotiating depths of several thousand meters
- Ocean floor is not at rest at all, earth quakes, volcanism, movements etc.
- Protecting the tunnel(s) against icebergs, submarines, sinking ships, terrorism and many other hazards not yet discovered or understood
- Providing enough electrical energy for the trains and all other necessary systems
- If pre feasibility studies are started and problems seem too great to overcome, still continue and not give up too easily (!)
- The financing of such a project in reality would be a challenge, at this point in time, cost estimates would be misleading and such a project would call for very large funds, no doubt.

This list is now long enough as a starting point and interested readers may add their own points! Take a look at the system shown in the two figures. This is what we have in mind.

Will we be able to solve these problems?

It may be a long way towards getting acceptance of such a project and its ideas. These illustrations were first published in ITA General Assembly in Amsterdam in 2003, and since then in several other places as ITA General Assembly in Seoul, 2006. The Discovery Channel also made a rather long presentation. Additionally the ITA of course has a website presentation. See reference at the end of this article.

Attracting competent people and sufficient funds is a challenge. We already are a group of four experienced engineers, but funds could be a problem, perhaps not impossible, the general interest is absolutely increasing.

The technical problems are of course formidable, but as long as the problems are identified it is possible to work on solutions and so far very few problems seem really impossible.

One of the biggest challenges is of course the depths of the ocean. Anchoring the tunnels to the bottom of the ocean would not be possible because the depth is too great. A system is proposed to use thrusters, structures having a lot of propellers balancing forces in all directions and keeping the tunnels in position. Systems with thrusters to keep structures, boats, platforms etc. in position, have been in operation for a long time. It is not a new and untried system at all.

Protecting the tunnel against icebergs, sinking ships, terrorism and other hazards, would be a big challenge, but has to be solved as a lot of other problems. Providing energy enough, perhaps nuclear based, would be a demanding task as well.

Have a look at the illustrations. If you have some good solutions, please contact me!

Håvard Oestlid

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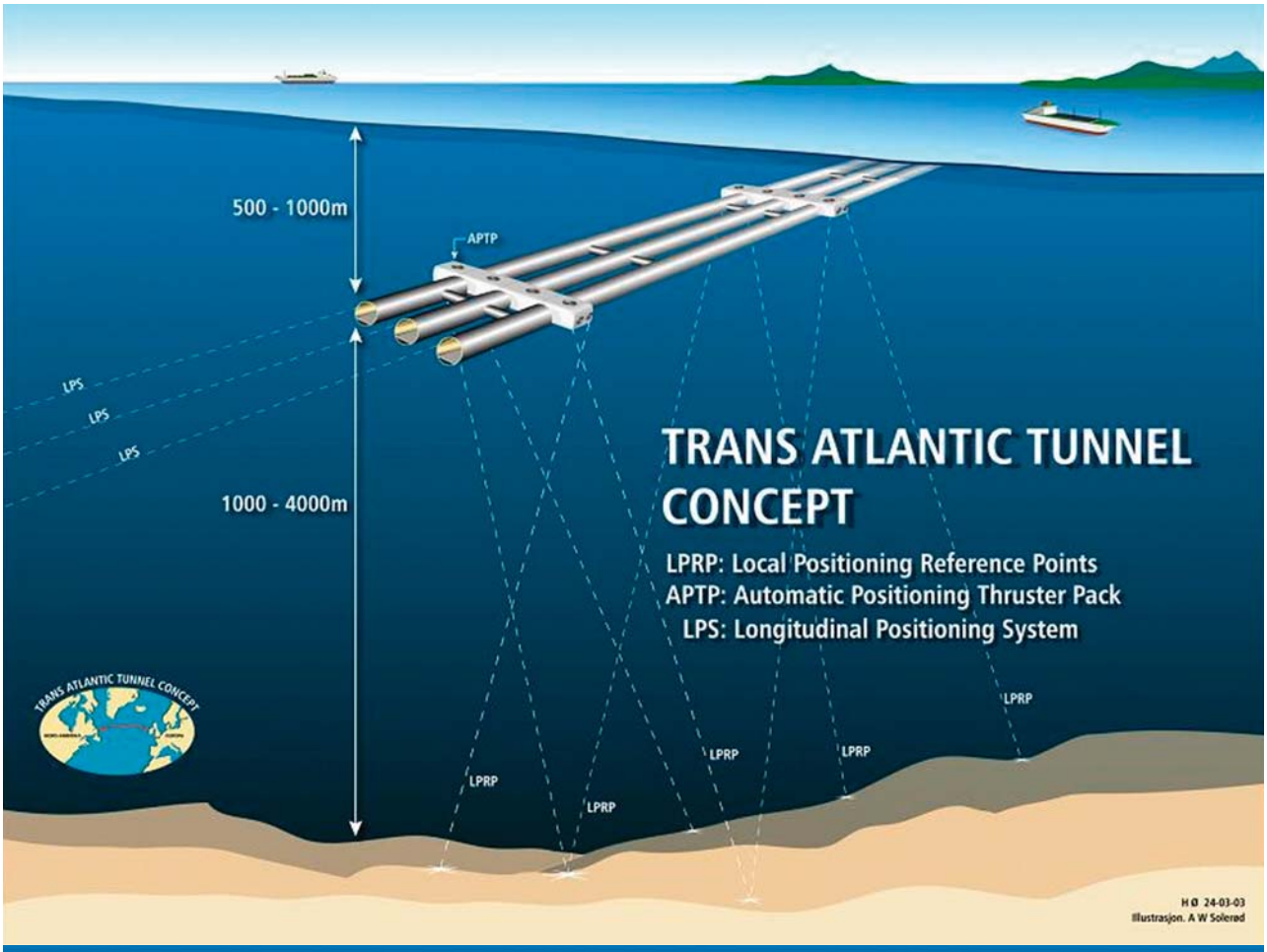
ITA reference:
http://www.ita-aites.org/cms/1574.html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LPRP: Local Positioning Reference Points
APTP: Automatic Positioning Thruster Pack
LPS: Longitudinal Positioning System
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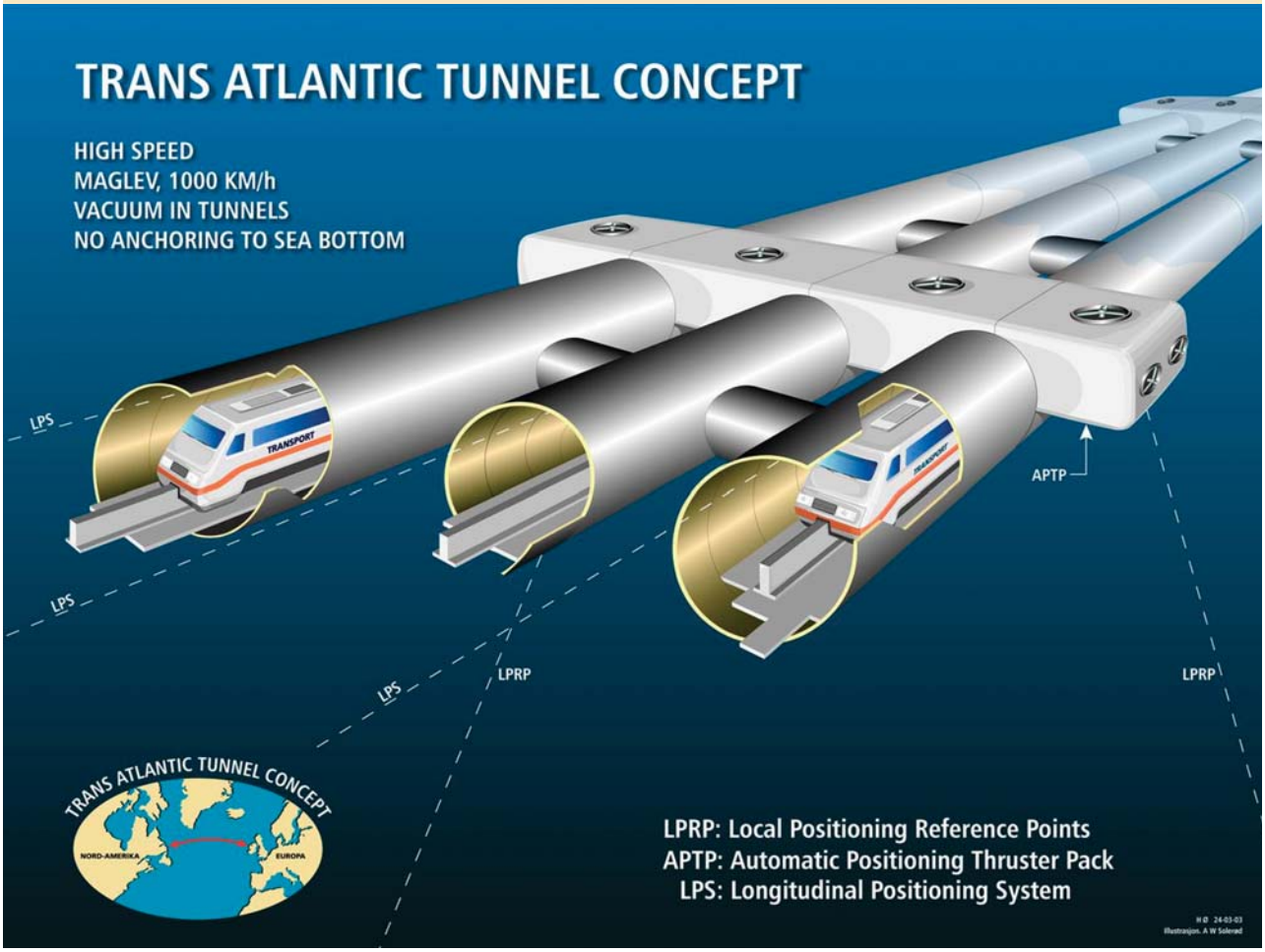
TRANS ATLANTIC TUNNEL CONCEPT
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MAGLEV, 1000 KM/h
VACUUM IN TUNNELS
NO ANCHORING TO SEA BOTTOM
LPS
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TRANSPORT
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LPRP
TRANS ATLANTIC TUNNEL CONCEPT
NORD-AMERIKA
EUROPA
LPRP: Local Positioning Reference Points
APTP: Automatic Positioning Thruster Pack
LPS: Longitudinal Positioning System

Life Cycle Assessment of Road Materials in the Danish Road Directorate

ROAD-RES is a new Danish life cycle assessment model for road construction. It is a method to evaluate resource consumption and environmental impacts in relation to the whole life cycle of a product or a project. The Danish Road Directorate whishes to gather more knowledge on how the life cycle thinking can be integrated into decisions in the road sector in Denmark. The model is now being tested in relation to the assessment of possible road materials for a new motorway in Jutland.

Life Cycle Assessment (LCA) is increasingly being used in different sectors in Denmark. The construction and waste sectors are examples of these. The Nordic Road Association has also seen LCA as a topic that should be focused on. Within the Association, working groups have concentrated on life cycle thinking for some years now.

LCA is a method for assessing products or systems where all contributions over the entire life are quantified and included. LCA includes input of energy and resources as well as output of waste and emissions to air, water and soil. Emissions contribute to several environmental impacts and global warming. Acidification and ecotoxicity are examples of environmental impacts that are assessed in an LCA.

The ROAD-RES model

ROAD-RES is a life cycle assessment tool for road construction and disposal of residues. The objective of the model is twofold:

i. To create an environmental management decision support tool for the road sector assisting in both designing of new roads and operation and maintenance of existing roads

ii. To create a decision support tool for the disposal of residues; either landfilling or recycling in roads.

EDIP97 is the default life cycle impact assessment method in ROAD-RES. The user can, however, supplement the model with other life cycle impact assessment methods, such as Eco-indicator 95, Eco-indicator 99 or CML 2001.

The model is divided into two parts: the road construction part and the disposal part. The road construction part, which is the most important for the road sector, can be used to assess road construction with both natural materials and residues. The ROAD-RES model enables the user to assess environmental impacts and resource consumption in different stages of the road construction and compare several solutions for road design and maintenance. The user can track where in the life cycle of a road construction environmental impacts are most important and which materials and processes contribute to the environmental impacts. If residues are used in the model, the environmental impacts from the residue are seen in context with the environmental impacts in the whole life cycle of the road construction.

The road construction part includes the following scenario-modules:

- Road
  - Motorway
  - Primary road
  - Secondary road
  - Urban road
  - Gravel road
- Parking area
- Embankment.

The scenario-modules for road construction are based on guidelines from the Danish Road Directorate and have been developed in close cooperation with the Road Directorate.

The life cycle of road construction is divided into three phases: construction phase,

operation and maintenance phase, and demolition phase. In the model, the construction phase is, however, divided into two screen dumps: *design*, where the physical structure of the road is defined and materials chosen and *construction*, where processes such as earth works, transportation and construction of materials are being modeled. In the operation and maintenance phase, activities such as regular maintenance, pavement maintenance and winter service are being modeled. In this phase, potential leaching from materials and distribution to the surroundings can be modelled. This part is particularly important if residues are used as road construction materials.

In the demolition phase, removal of road materials and disposal or recycling of the materials can be modelled as well as the rehabilitation of the area. In reality, demolition of roads is something that hardly ever happens and therefore inclusion of the demolition phase is optional in the ROAD-RES model. However, this part can be important for the results of the modelling, especially if residues have been used for the road construction.

Testing of the model

One thing is to have a model that works. Another thing is to see if the model can give valuable results to the road sector. Can LCA and the ROAD-RES model be a valuable decision support tool in the road sector, for example when materials for a road are chosen? Can LCA give valuable information in the Environmental Impact Assessment (EIA) for a new road construction?

To be able to answer these questions, the Danish Road Directorate has chosen to use LCA and the ROAD-RES model in an 11 km motorway project in Jutland. The goal of the LCA is to focus on the road materials that can be used for such a construction. Several different combinations of materials will be assessed, including a traditional construction with asphalt wearing course and base course on top of a granular road base. Other variations, such as thin asphalt pavement, cement stabilized base, concrete road and lime stabilized subgrade are also included in the assessment.

The Road Directorate expects this project to be completed in 2007.

Harpa Birgisdóttir and Knud A. Pihl

Further information:

A Ph.D. thesis: Life cycle assessment model for road construction and use of residues from waste incineration (http://www2.er.dtu.dk/publications/fulltext/2005/MR2005-106.pdf)

Published article: Birgisdóttir, H., Pihl, K.A., Bhander, G., Hauschild, M.Z. and Christensen, T.H. (2006). Environmental assessment of roads constructed with and without bottom ash from municipal solid waste incineration. *Transportation Research Part* D, 11, 358-368.

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Road Salt and the Environment
– a Complex Problem

To melt snow and ice which would otherwise give rise to slippery conditions road management authorities spread de-icing salt on the roads. In various ways, this salt is dispersed into the surrounding nature where it causes damage. The VTI Environmental Model is one way of calculating the effects of exposure to salt.

The regulations of the Swedish Road Administration for winter road management specify that sodium chloride – de-icing salt – is to be used for skid prevention. The salt melts ice and snow on the carriageway when it is as cold as -12°C, in contrast to normal conditions when ice and snow do not melt until the temperature has risen to 0°C. The salt has the capacity to "cheat" winter and free roads of snow and ice even when temperatures are below freezing. Unfortunately, salt does not stay on the road where its properties are desirable, but is removed from the road by the action of traffic and spreads into the surrounding nature. Several studies have shown that vegetation, such as conifers, can be damaged both when road salt comes into contact with their roots, and when it is deposited on the outside of the needles. One important and timely issue is the contribution that winter road management makes to the salination of groundwater resources in Sweden. The principle laid down by the EU framework directive for water is that the polluter must pay.

PHOTO: VTI

The slipstream created by lorries gives rise to turbulence that keeps salt suspended, and wind can then spread the salt into the surroundings.

Conifers are most sensitive to salt

Exposure to de-icing salt gives rise to negative effects in various ways. Growth of trees near the road may be retarded, species composition changed, and the visual qualities of the landscape are altered because of the changes in the appearance of, primarily, conifers. Damaged trees along roads create a bad impression, and owners of land near roads that are salted who have the vegetation in their gardens damaged are worried and displeased. Salt can also be carried along by groundwater and cause damage to vegetation a long distance from the road.

Symptoms on conifers damaged by salt are usually manifested during the spring thaw period at the end of February or in March/April. The most common symptoms are that the needles first turn yellow, then the colour of bronze and finally brown, when they die and fall off. Depending on how damage is defined, it is either spruce or pine that is the most sensitive species. Spruce is damaged most easily, but nevertheless has the ability to shed the damaged needles and put out new shoots which hide the damage during the summer. The needles on pine, on the other hand, are attached differently, and the damaged needles are therefore left on the branches in the summer. The new shoots on pine do not hide the damage in the same way as those on spruce, and pine may therefore appear to have been more extensively damaged than spruce.

The Environmental Model makes analysis possible

In Sweden, we have used sodium chloride on the state-maintained road network since the 1970s. Since the start, the amount of salt that is used has doubled, but less is now being spread.

– It has been known since the beginning that salt is bad for the environment, but this has not received priority at all times, says Göran Blomqvist, VTI, who is conducting research into the effects of road salt on the environment.

Several measures are now being taken to deal with the problem. In experiments, roads have been resurfaced to make them smoother and easier to plough. This, together with improved plough blades, makes ploughing more effective, and the amount of salt that is spread can therefore be reduced. There are also experiments in which de-icing chemicals which might replace or complement road salt are investigated. One example is to remove part of the salt and replace it with types of sugar that do not damage nature as much as sodium chloride.

– We are now making a conscious effort to reduce the amount of salt, says Göran Blomqvist. We are mainly working on improving the ways in which salt is spread, and to train the contractors who are employed in road management.

It is not enough to "spread as little salt as possible" to minimise the damage caused. The pattern of exposure itself (quantity, time of year, number of exposures, etc) also has a large effect on how damage to vegetation arises. It is here that the VTI Environmental Model comes in.

The aim of the Environmental Model is to simulate the exposure to salt of the road environment as a function of weather, road conditions, traffic and salting strategy. By converting salt exposure to environmental effects on vegetation and groundwater in the vicinity of the road, the environmental benefit of changes in road management strategy, in relation to other effects and benefits, can be analysed. It is traffic, together with road conditions and wind, that seems to have the greatest significance for the mechanisms which remove salt from the road. But vehicles also differ in their potential to create splash and spray which spreads road salt to nearby vegetation. In other words, salting and winter road management are a complex system. Finding a balance and devising a winter road management strategy that functions as optimally as possible is a project that goes on all the time.

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Request for Use of Gas in Two Ferry Links

In a press release in mid October 2006, the Norwegian Minister of Transport and Communications, Liv Signe Navarsete, declared that the use of gas as engine fuel will be one of the conditions for a competitive tendering which NPRA is going to announce for two ferry links in Norway.

In Norway the ferry links are part of the highway system and ferry boats operating on the two links Flakk–Rørvik in the county of Southern Trøndelag and Halhjem–Vaage in the county of Hordaland shall use gas as engine fuel in the future.

– The use of gas is environmentally friendly and a solution for the future. The emission of NO_x from a gas driven ferry boat is only 10 per cent compared to the emission from a ferry boat driven by diesel oil. Thus the transition to the use of gas driven ferry boats will reduce the emission of NO_x very significantly. The use of gas driven ferry boats will also give us another environmental advantage in the form of a 25 per cent lower emission of CO_2 compared to the emission from a ferry boat driven by diesel oil. A part of this picture is that the transition to the use of gas as engine fuel will help the development of Norwegian competence and technology in this field of exciting challenges, both nationally and internationally, the minister stated in the press release.

Thorbjørn Chr. Risan, NPRA, Norway

PHOTO: KNUT OPEIDE, VEGEN OG VI

The ferry boats operating the link Flakk–Rørvik in Southern Trøndelag (Mid Norway) is one of two ferry links which will be using gas as engine fuel in the future.

Norwegian Report on Low Emission Society in 2050:

How Can the Transport Sector Contribute?

In October 2006 the Norwegian Commission on Low Emissions delivered its report to the Norwegian Environmental Ministry. The commission believes that it is necessary, feasible, and not prohibitively expensive to reduce Norway's greenhouse gas emissions by two thirds by 2050. The commission emphasises that the implementation of the low emission scenario primarily is a policy decision challenge.

The Low Emission Commission emphasised technical measures in order to achieve a reduction of two thirds from 1990 to 2050. The commission states that a reduction of 50 to 80 per cent is both necessary and technologically feasible and that the implementation of the necessary abatement measures can be implemented without noticeable socio-economical costs. A condition for goal achievement is, however, a holistic and durable climate abatement policy, and the necessary long term framework conditions have to be set today. The measures shown in the figure cover areas such as electricity production, transport, process industry, heating, waste disposal, as well as oil and gas activities on the continental shelf. In order to facilitate the implementation the Commission also proposes basic measures such as an information campaign and the implementation of a technological development and investment package.

Oil prices crucial for cost efficiency

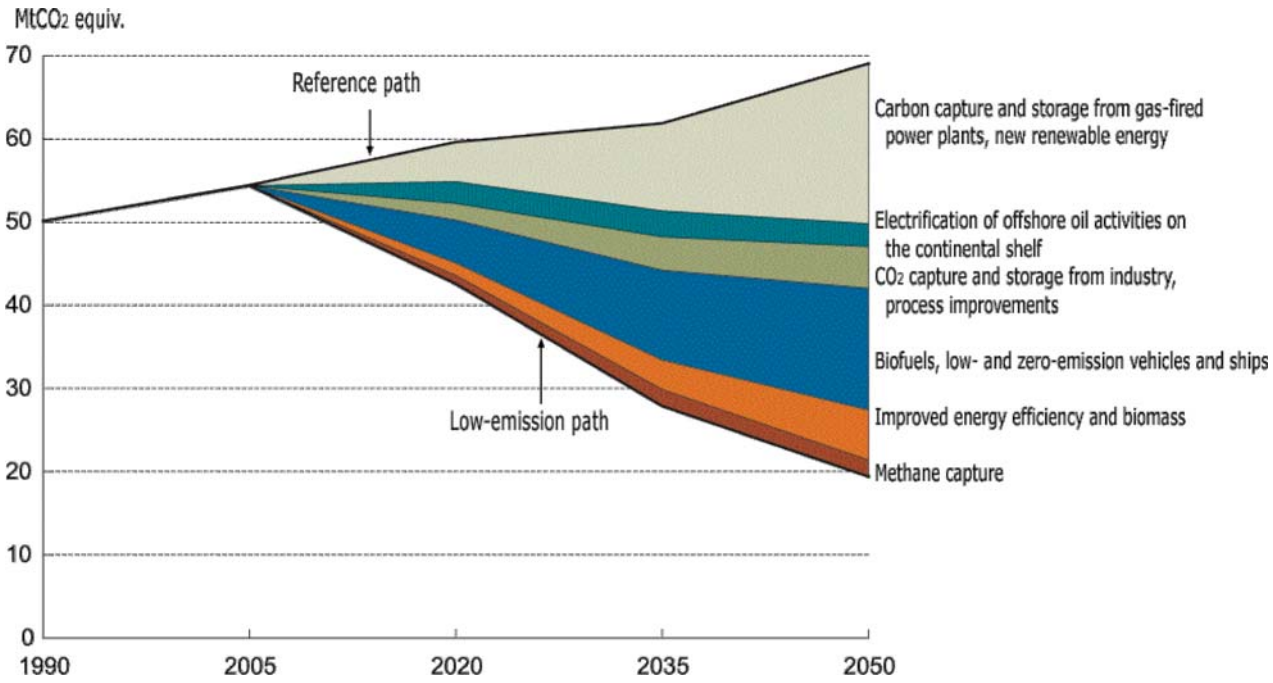
On a mid term basis the oil prices will be crucial for the estimation of cost efficiency of climate emission abatement. In traditional abatement measure analyses the costs are estimated on basis of long term oil prices below US$30 per barrel crude oil (Leite/Herzberg 2005). A study from the Institute of Transport Economics shows that the use of CO_2 for enhanced oil recovery, technical measures on vehicles and electrification of the offshore oil installations are highly sensitive to changes in oil prices. For abatement measures within stationary energy supply and transportation, a presumed higher oil price will further increase cost efficiency.

Transport important for goal achievement

The Low Emission Commission's business as usual scenario presupposes a doubling of the transport volume by 2050. Due to technical improvements, the emissions will only increase by 16 per cent. The overall share of the transport emission is expected to be 30 per cent.

The Commission describes four well-known technological measures to reduce the emission from transport sector from 16 Mtons in 2005 down to 4 Mtons CO_2-equivalents in 2050. Higher oil price can turn out to be crucial for the implementing of such abatement strategies.

- Energy efficient vehicles such as hybrid and electric motor cars will clearly be cost efficient on the basis of today's cost estimations, if we assume higher oil prices



Scope of potential CO_2 reduction.

- Higher oil prices will also make the first generation of 5 per cent biofuel cost efficient, and will also make second generation biofuels more feasible in a medium term perspective
- Zero emission vehicles based on hydrogen will still be in need of major improvements in production costs.

New technology is not just coming along

Introducing new technology is not sufficient in itself, especially if the new technological solutions require large investments and compete with existing large technical system. The political decision challenge is hence twofold.

Firstly, it is most important to avoid technological dead ends. Is it better to develop a distribution system for an 85 per cent ethanol blend in petrol or should we wait for the second generation biofuels? Is a technological breakthrough with regard to fuel cells more likely than a breakthrough for battery cells for electric motor cars?

Secondly, research and development must be appropriate to the development stage. Where are we according to the large technical system that has to be in place for implementing a certain technology option?

Bring transport planning back in?

Implementing abatement measures related to land use and transport planning clearly gives economic benefit to the society. There are, however, two possible and partly opposite attitudes towards land use and transport planning as a climate abatement strategy. Analyses of the Norwegian transport sector shows that the medium term effects on greenhouse gas emission are quite modest. Implementing a package of measures to reduce the car driving, such as restrictive parking policy and improved public transport in the largest Norwegian cities will only contribute with a reduction of about 600 000 ton of CO_2 in 2020.

Even if the measurable effects in the short run are minor, the planning decisions that are taken today will influence the possibilities for reducing the transport volume in the future. If we assume lasting high energy prices, then transport planning measures can prove to be a good strategy.

Title: Oil price influence on cost efficiency of climate abatement measures (In Norwegian)
Author: Tore Leite
TØI report 852/2006.
Available on www.toi.no.

PHOTO: OTTO KLEPPE, NPRA

With a total length of 196 m the Flisa Road Bridge in Østerdalen holds the longest timber bridge span in the world. The bridge is constructed for full traffic load and it was finished in 2003 at a total cost of about EURO 3.75 million.

Modern Timber Bridges in Norway

Timber bridges have gained a foothold in Norway as a competitive alternative to steel and concrete structures. Ten per cent of all new comparable road bridges built in 2000–2003 were made of timber. From 2004 the number of new timber bridges has slightly been reduced, but the magnitude, the span and total length, have increased.

Currently the majority of new timber bridges have been constructed in the inner regions of Eastern Norway, although an ever increasing number of exciting timber bridges have appeared in the coastal areas as well. When designing timber bridges one had to meet the challenge of demonstrating that it is possible to build these bridges in such a way that the process of deterioration is slowed down. The experience in recent years has indicated that timber bridges are a competitive alternative to steel and concrete bridges from a cost and a durability point of view.

Timber bridges in Norway

Since the start in 1995, this most recent period which represents a renaissance for timber bridges, some 30 pedestrian bridges have been built in connection with state and county roads along with 29 road bridges including the world's longest span for a road bridge which is Flisa bridge (2003) with a span of 70.3 m. Tynset bridge (2002) holds a span of 70 m and both of them are truss bridges. Recently constructed arc bridges are Ulnes (2003) and Nybergsund bridges (2005) with span of 35 and 38 m respectively. They are 105 and to 196 m long. It is worth mentioning that all these timber road bridges have been designed to bear full traffic load.

In cooperation with an artist, Vebjørn Sand, a sculptural pedestrian timber bridge, Leonardo da Vinci bridge, has been constructed. It has been the most famous bridge in Norway in terms of presentation in foreign media most likely because of its sculptural appearance and the fact that it is based on ideas from a drawing made by Leonardo da Vinci. The concept dates back to around 1502 as sultan Bajazet II considered replacing a floating timber bridge across the Golden Horn with a more permanent one. In a letter, Leonardo da Vinci made a proposal for a stone bridge and description of how to construct the bridge. This timber bridge in Ås has taken the ideas from the original stone concept.

The new solutions when designing timber bridges are related to stress laminated timber slabs, which have been formed into jointless bridge decks, new timber jointing methods such as slotted in steel plates and dowels, and methods for protecting the constructions against moisture.

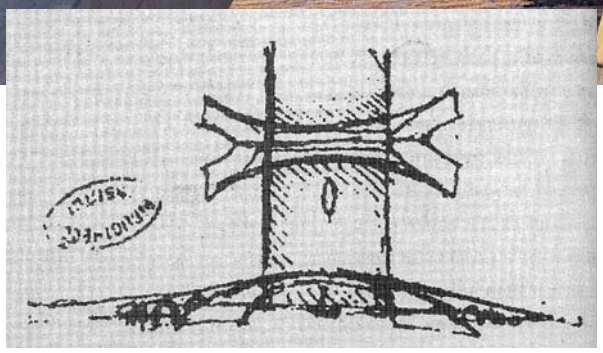
We have a policy of not hiding our timber bridges by cladding them. In fact we prefer to show them off. Many people experience warm feelings when seeing a beautiful timber bridge. A bridge should itself appear attractive and display harmonic design features and must be adapted to the surrounding landscape. This raises additional challenges with regard to durability.

Protection and lifespan

The Norwegian Public Roads Administration requires all bridges to be built with a 100-year life-span by a minimum level of maintenance. No exceptions have been made in the case of timber bridges. Our chosen solutions for achieving these requirements involve a combination of constructional

PHOTO: JIRI HAVRAN

Leonardo da Vinci Pedestrian Bridge in Ås close to Oslo has a total length of 109.2 m. The main span is 40 m. The bridge was constructed in 2001 at a total cost of approximately EURO 1.5 million.



The original bridge concept made by Leonardo da Vinci.

and chemical protection. The former normally involves the use of copper plates on all upper sides, while the latter refers to chemical protection applied to the timber. Whenever chemical protection proves unsatisfactory, constructional solutions will be applied for the lateral surfaces as well. Achieving a 100-year life-span has been a severe challenge. We now believe we have the question of life-span under control and monitor some of the bridges in order to record the development and deterioration process.

Readings taken from instruments indicate that moisture levels in the timber vary very little over a year, lying at perhaps around 2 per cent. Current figures from monitoring indicate an average moistures content of about 11 per cent. As we know, the process of decaying does not start until moisture levels have exceeded around 20 per cent. We would therefore claim that our protective measures are working as anticipated. This is obtained by using pressure treatment with creosote as the principal preservative. Creosote is a type of oil capable of repelling much of the surface water. It has been in existence for over 100 years, and both its durable qualities and its associated environmental problems are well known. Copper plating on the upper sides will last for more than 100 years.

Costs

Timber bridges are competitive compared to steel and concrete bridges. The related competing industries have also understood this. Sometimes timber has been preferred to other materials not because of the poor construction costs involved; more often they are chosen because they give the lowest total cost given other criteria for the specific bridge.

Cost depends on the type of bridge, its dimensions, time of erection and location. We do not anticipate timber taking the lead in bridge construction; rather it will represent a reliable and competitive alternative to other type of construction materials.

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Conflicting Purposes in Urban Streets:

Lesson Learned from a Traffic Calming Project in Oslo

Traffic calming in urban streets improves the living environment and welfare of residents and other users. Traffic calming may come in conflict with the needs for regular deliveries and car parking in shopping streets. These conflicts may be difficult but necessary to solve.

Traffic calming in urban streets is done to reduce car traffic to acceptable levels. The purpose is to improve the human environment for residents and other users. This can, i.a., be done by creating pedestrian zones, building broader sidewalks, changing the roadway and upgrading the visual urban street environment. Fewer parking areas will reduce the number of cars in the traffic calmed street and provide necessary qualitative space for other users.

An evaluation of an urban street in Oslo, Tøyengata, shows the effects of such changes on goods delivery, parking and the residents' and users' perception of the street environment. For commercial enterprises, goods delivery and customer parking are the main worries after the changes. Visitors and residents had a positive perception of the environmental quality of the street, but for them the changes have been less noticeable. Relatively comprehensive changes are therefore needed in order to improve the situation in the street as perceived by residents and visitors.

The urban street has to fulfil both residential and commercial purposes

An urban street will often join several functions that fill different requirements. It is residential environment for adults, youth and children, shopping area for the neighbourhood community and for the region, and traffic area for people in transit to work place, school or leisure activities. These different requirements may be in conflict with each other and have to be balanced in the planning of an urban street environment. The needs of the residents may also vary. They may seek an attractive and quiet neighbourhood with clean air. On the other hand they are in need of parking places. The commercial community requires the street to be an attractive shopping environment, but they are also in need of customer parking and sufficient conditions for supplying goods. A thorough analysis of the local requirements, and how they can be implemented, is needed when planning a traffic calming project.

Tøyengata – a typical urban street in the centre of Oslo

The conclusions for the evaluation of an urban street in Oslo – Tøyengata – are based on interviews with commercial enterprises and a street survey.

In Tøyengata the car density among the residents was comparatively low – also before the rebuilding of the street. Two surveys show that the street had a large share of visitors that travelled with public transport or as pedestrians. The street was thus well suited as a traffic calming project, as the advantages of low car traffic was outweighed by the deterioration of the parking facilities.

The street has several shops with frequent goods deliveries. The traffic calming project did not lead to significant changes in the commercial character of the street. There was, however, a tendency towards reduced commercial activities in parts of the street where most parking spaces were removed. In other parts of the street the business was prospering. As such, the traffic calming project did change the commercial environment and influenced the conditions for specific business activities. Both planners and decisions makers must therefore consider micro level effects of their policies.

Dialogue to reduce conflicts

Evaluations of Norwegian traffic calming projects have revealed that goods delivery is not well ensured, but that the commercial communities are adjusting pragmatically. In some cases the physical conditions may limit the choice of good delivery solutions. An open dialogue with local trade is thus

Tøyengata in Oslo.

PHOTO: ARE WORMNES

important in planning traffic calming projects. The evaluation of Tøyengata shows that the retailers and some service providers perceived the delivery of goods as not satisfying, but that the problems were limited to specific shops with frequent deliveries and/or especially bad conditions for delivery. The evaluation also shows that the need of parking and goods delivery facilities has to be considered continuously, as commercial enterprises tend to come and go. The measures proposed by the informants were, however, specific and limited in scope. Smaller changes may therefore be sufficient to improve the conditions for merchants in the street. In Tøyengata a rigid enforcement of the parking rules was thus perceived as a problem among the commercials. Information, dialogue and signposts can be used as measures to avoid conflicts.

The scheme must be visible

For some users of an urban street, traffic calming measures may necessarily lead to inconvenience. In order to make traffic calming measures in urban streets more acceptable among car users, commercials, visitors and residents, the changes have to be noticeable. A street survey in Tøyengata revealed that the users did not perceive any major changes in street environment quality after the changes. The measures were not sufficiently visible. This may be explained both through small changes in the use of the street room and by the fact that the traffic was already significantly reduced through a street barrier.

Title: Evaluation of a traffic calming project - Environment, parking solutions and delivery of goods in an urban street
Authors: Tore Leite and Aslak Fyhri
TØI report no 846/2005.
Available on www.toi.no

Noise – an Increasing Environmental Problem

Noise is an environmental problem which has been attracting increasing attention in recent years, and it is one of the negative environmental effects which the public regards as a more serious problem today than at the beginning of the 1990s. The problem is manifested in the form of sleep disturbances, stress related symptoms etc, and research in recent years has also suggested that it increases the risk of cardiac and vascular diseases. It is the transport sector that causes most noise problems in the form of aircraft, road and rail traffic noise.

For over thirty years, VTI has carried out research on road traffic noise. The work at VTI has had a certain focus on the noise properties of road surfacings and vehicle tyres, through the work of Ulf Sandberg, who is now also adjunct professor at Chalmers University of Technology. For example, under Ulf Sandberg's direction, measuring methods for tyre/road noise and road surface characteristics have been developed and made into a number of international standards.

Since 2005, also Mikael Ögren, who has a doctorate in engineering acoustics has been working at the VTI department for transport and environment. He is focusing his research on the propagation of sound outdoors, for instance on noise from road and rail traffic.

– We all experience sound, but few of us know how much effect it has on us.

One problem in the transport sector is that the whole cost of noise pollution is not borne by those who cause the noise. In order to tackle this problem from the railways, the Swedish Riksdag (Parliament) has resolved that train operating companies which use state track infrastructure shall pay charges commensurate with the cost which noise effects impose on society. For railway noises, this implies that pricing is based on the increase in noise level which one further train gives rise to. VTI considers that such a charge is an effective means of obliging operators to reduce their noise emission.

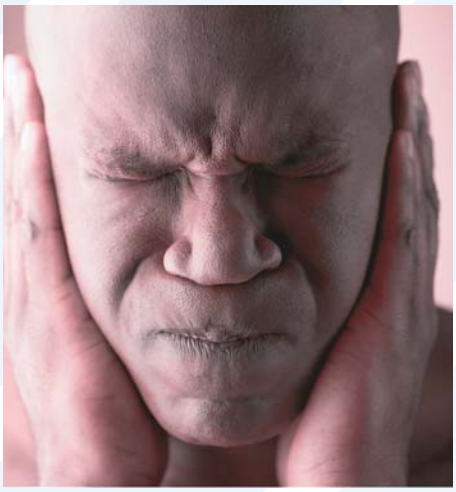

PHOTO: INGRAM

VTI has demonstrated that, using existing knowledge, it is possible to add a noise component to track charges. The recommended values which apply at present for the costs of noise, based on noise from road traffic, can be used, and the noise calculation models which are available can be easily modified to apply to rail traffic. VTI is of the opinion, however, that further research can improve the basis for the evaluation of noise, and that there is also a need for more information concerning the number of people who are exposed to noise along rail routes.

Road traffic also creates noise at levels that are harmful to our health and wellbeing. Work is in progress on projects to develop quieter tyres and quieter road surfacings. Mikael Ögren sees many opportunities for VTI to make use of the knowledge concerning sound, not only in traffic noise research.

– A lot of work is being done at present on graphics in our simulator, but I believe that we can make improvements here also and create a more credible acoustic environment, he says in conclusion.

Magdalena Green and Sandra Johansson, VTI, Sweden

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Sharing Knowledge on Noise – CEDR Has Started a Noise Working Group

CEDR, the Conference of European Directors of Roads, has set up a number of working groups, including one working group on noise issues. The noise group is led by the Road Directorate/Danish Road Institute in Denmark and includes active members from the national road administrations in Austria, France, Germany, Greece, Holland, Hungary, Iceland, Ireland, Italy, Norway and Sweden. There are also corresponding members from Belgium, Estonia, Finland, Spain and the United Kingdom.

The group has sent out a questionnaire to all member countries in CEDR on issues such as noise and planning, guidelines, noise mapping, The European Noise Directive (END), noise and road maintenance, noise barriers, communication of noise issues etc. A separate questionnaire will be sent on the question of needs for research and knowledge gaps. The answers received from the questionnaire will be analysed and discussed at the next meeting to be held in Paris in March 2007. At that meeting a special seminar will also be held to discuss future research in noise matters. In autumn 2007, a meeting will be held where the subject of tire noise will be taken up focussing on the EU regulation on tyre noise emissions. In 2008, final documents will be ready and distributed to all CEDR institutes, which will analyse the answers received from the questionnaires and give results of the seminars in connection with the meetings. A decision will also be taken at that point whether the work in this group should continue.

Reducing Noise at the Source – A Nordic Perspective

By combining different measures a noise reduction of about 10 dB(A) may be possible in a 10–15 years perspective. If noise reduction of this size is demanded, cooperation between the Nordic countries on developing and testing of different road surface types is necessary. An important task is to find out how to construct roads with drainage systems that work in freeze-melt conditions with partial ice-formation, and that can survive winter maintenance activities. Denmark, having a more continental climate and having undertaken long time durability testing of some road surfaces, is already in the position to deploy low noise surfaces where this proves to be cost efficient.

The most promising measure in order to achieve at-the-source noise reduction in the short term is environmentally motivated speed reduction. Noise emitted from vehicles increases with speed. It is mainly tyre-road surface noise that is reduced. Apart from reducing noise, speed reduction will:

- Improve traffic safety
- Reduce amount of combustion particles (down to a certain speed level)
- Reduce road surface wear, and particle emission
- Reduced resuspension.

When reducing the actual speed by 10 km/h, a noise reduction of about 2–3 dB(A) can be achieved. Reducing speed limits alone is not enough, because driver compliance with the new levels is low. Different types of traffic enforcement are therefore necessary. The political acceptance for the measure is often low. The advantage of this measure is that it is efficient from the first day of implementation, and cheap compared to other measures.

PHOTO: ASTRID AMUNDSEN

Potential noise reduction from low noise road surfaces

Unlike vehicle and tyre noise, there are no EU regulations for surface type. The choice of road surface is up to the road owner.

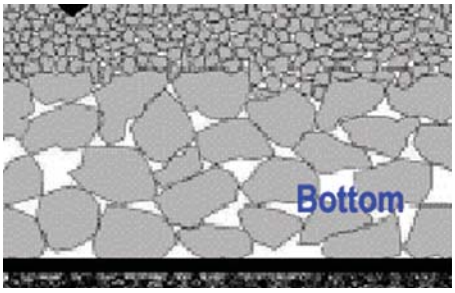
Low noise road surfaces can be divided into three types:

- Thin/dense surfaces
- Porous surfaces
- Poroelastic surfaces.

Thin surfaces are being tested out in several countries, including the Nordic countries. A noise reduction of 2–4 dB(A) is commonly achieved on the different test sections. The advantages of thin surfaces are mainly due to durability and costs.

Noise reduction of 4–6 dB(A) are achieved on tests in real traffic situation, with two layer porous asphalt. The problem with porous surface today, and especially in the Nordic countries, are clogging and freezing of ice in the drainage systems. Poor friction and adhesion problems are other problems with today's porous surfaces. The surface type is usually used on high speed roads, where the high speed seems to prevent some of the clogging. High pressure water spraying and sucking can reduce the clogging somewhat, and the cleaning technique for these kinds of surfaces is improving.

PHOTO: VTI/HEJDLÖSA BILDER



Twin layer porous asphalt. Source: Berengier and Licitra 2003

According to producers, noise reduction of 8–10 dB(A) will be possible when the technology has improved further. At present this type of surface is expensive (costs at least 50 per cent more than conventional surfaces), and has a short lifespan, but even with this taken into consideration, these kinds of surfaces are usually cost-effective (if used on high speed roads in areas highly populated).

Noise reduction from tyres

The difference between the noisiest and least noisy tyres on today's market can be as much as 4–5 dB(A). The EU tyre directive is so moderate that all tyres produced today fulfil the requirements and will do so till at least 2011. The directive provides no incentive to tyre producers to improve the noise quality of their tyres.

An optimal combination of tyre and road surface properties is necessary. When different tyres are tested on different road surfaces, up to 9 dB(A) difference in noise levels are measured. For Nordic authorities and other countries with similar climate, it is important to determine which tyre and surface type that is most efficient for these conditions, and to ensure that imposed EC-standards are not only appropriate for continental road surfaces, but also Nordic types with rougher surface texture.

To promote the use of low noise tyres, different financial incentives might be considered.

Engine noise reduction

Even if there is a potential for further noise reduction from the engines, this is not likely to come through regulations, due to the fact that new vehicles already fulfil the EU requirements. While the potential for power train emission reductions is there, consumers are unwilling to pay for less noisy vehicles

A 10 dB(A) noise reduction may be possible in a 10–15 year perspective

By combining different measures a noise reduction of about 10 dB(A) may be possible in a 10–15 years perspective. If noise reduction of this size is demanded, cooperation between the Nordic countries on developing and testing of different surface types is necessary.

Research show that Nordic winter conditions demand somewhat different types of low noise surfaces, than southern parts of Europe. Different types of porous surfaces need further testing under Nordic conditions before they can be used on a more full-scale basis (arterial-roads near urban/residential areas, on roads with speed level above 50 km/h). Use of low noise dense surface types, are less problematic and can be implemented as of today. To optimize the noise reduction from surface/tyre, surface types and tyre types adequate for Nordic conditions need to be matched as well as possible.

Using speed reductions as a noise reducing measure is a measure with instant impact both on noise and air quality, and it is cheap to implement. But it may be politically hard to get acceptance fore this type of measure.

Astrid Amundsen, TØI, Norway

Title: A Nordic perspective on noise reduction at the source
Authors: Astrid Amundsen and Ronny Klæboe
TØI report no 806/2005. Available on www.toi.no

Success Factors for Local Traffic Noise Abatement

Road noise nuisance is a huge problem in Nordic municipalities. It seems difficult to meet national targets for noise abatement. One reason is lack of municipal attention. This study of municipal noise abatement policy shows that road traffic noise abatement in general does not seem to be institutionalised, neither in the municipal organisation nor in the near surroundings. We point out important conditions for making municipalities more active in implementing road noise abatement measures in existing dwelling areas.

PHOTO: VTI/HEJDLÖSA BILDER

Denmark, Sweden, Norway and Finland all have ambitious national targets regarding reduction of traffic noise exposure in residential areas. However, it seems difficult to reach these targets. A gap exists between politically determined national targets on the one hand, and achievements on the other, a gap which constitutes the starting point of this article

Road traffic noise is to some extent considered when planning new dwelling areas or new roads. The more difficult problem, however, is noise nuisance in situations of dwellings and roads that already exist. Some of the responsibility for reducing road traffic noise lies with the municipalities. In Denmark and Sweden 85 per cent of the persons who are exposed to road traffic noise above the threshold level of 55 dB live nearby municipal roads. In Norway and Finland the equivalent figures are approximately 50 per cent. Furthermore, an EC Directive from 2002 stresses the role of the municipalities.

The anatomy

Taking point of departure in literature as well as in two case-studies, a picture of the anatomy of the municipal noise abatement policy can be sketched. That is, the characteristics of road traffic noise abatement as a policy field in municipalities. The general picture is that one can not expect municipalities to take responsibility for road traffic noise abatement in existing dwelling locations. The issue seems only to a limited extent to be object for political attention in municipal organisations. While the issue of traffic safety is characterised as a question of major importance, noise abatement is characterised as cosmetics. In many municipalities noise abatement is influenced by the fact that it is only a minor part of the relevant civil servants' responsibilities. Further, noise abatement is not seen as a core task in any professions. For these reasons we do not find many dedicated individuals within noise abatement. Lack of economic means also constitute a reason for not picking up the problem of road traffic noise. It is not an easy task, therefore, for municipalities to engage in road traffic noise abatement in existent dwelling areas. However, the largest municipalities are an exception.

The surroundings

The problem of road traffic noise abatement in existing dwelling areas is characterised by diffuse responsibility. Furthermore, it is not possible to determine exactly when the problem arose. Road traf-

PHOTO: JOHNNY DAHLGREN

fic noise is a phenomenon which develops slowly and slinking. For the largest municipalities, however, it seems possible to draw a more positive picture. Here, re-urbanisation or gentrification can create circumstances where citizens with plenty of resources move into areas with traffic noise nuisance, and demand municipal abatement measures.

Regarding states and transverse networks, only Norwegian legislation requires that the road authorities establish noise protection in dwelling areas exposed to more than 42 dB indoors. In Denmark, Sweden, Norway and Finland currently no or few financial state contributions are available for municipal activities in the field of road traffic noise. Also the national states' pedagogic policy instruments are limited. At least in Swedish municipalities, professional noise networks are demanded, but few networks exist. Only in Sweden road traffic noise is an important topic in the national organisation of municipalities, and in all four countries, the large, national environmental non-governmental organisation do not deal with the topic at all.

All in all, abatement of road traffic noise nuisance in general does not seem to be institutionalised, neither in the municipal organisation nor among other stakeholders in the municipality, though possibly, the large municipalities represent an exception to this rule.

The conditions

However, two case studies of the Swedish capital, Stockholm, and the Danish town, Hørsholm, constitute examples of municipalities which – in spite of the general framework conditions – are carrying out extraordinary efforts to reduce road traffic noise. Inspired by literature and the case studies, some conditions which are important for making municipalities actively provide for and implement road noise abatement measures in situations of existent dwellings and roads, can be outlined (see box). The conditions relate to characteristics of the municipal organisation, citizen activities, and the state's legislative, economic and pedagogic incentives vis-à-vis the municipalities.

Claus Hedegaard Sørensen, Institute of Transport Economics, Norway

Title: How to encourage traffic noise abatement in Nordic municipalities?
Authors: Claus Hedegaard Sørensen and Tore Leite
Report from Nordic Council of Ministers, 2007, forthcoming.

10 important conditions for local authorities to take an active role in traffic noise abatement

- The politicians enthusiastic for the issue are in power and pay attention at decisive phases of the process.
- A competent municipal administration.
- The municipal administration is capable of using any opportunity to advance road noise abatement measures.
- The municipal administration continuously prepares status report to the politicians. These status reports ensure that the politicians remember the need for abatement of road traffic noise in existing dwelling areas.
- Citizens patiently and persistently continue to stress the need of noise abatement policies and/or measures.
- A positive dialogue is obtained between citizens, civil servants and politicians.
- The municipality as a regulatory authority can instruct road authorities to provide noise abatement measures.
- Financial state contributions are available for municipal activities in the field of road traffic noise abatement.
- State action plans and state publications exist and function as pedagogic policy instruments.
- The state heads for ambitious policies in the field. Such policies might stimulate municipal efforts.

Integrating Noise in Pavement Management Systems for Urban Roads

A great part of the road networks where noise levels exceed the national guidelines and limit values, and where there is annoyance in surrounding residential and recreational areas, are municipal roads. For noise abatement, it is therefore important to integrate noise in the Pavement Management Systems normally used by municipalities.

Different types of noise reducing pavements exist that are suitable for use on urban roads. Road administrations in urban areas in Europe have the responsibility of operating and maintaining large road networks. Noise can be integrated as an important factor together with traffic safety, driver comfort and durability when existing roads are maintained and when the pavements are being renewed.

Pavement Management Systems (PMS) are used to support and plan road maintenance work. As a part of the EU project SILENCE, the Danish Road Institute (DRI) has produced a report on the possibilities of integrating acoustic parameters in Pavement Management Systems.

Existing Pavement Management Systems use two main strategies for collection of pavement condition data:

1. Visual inspections (often used by municipal road administrations)
2. Technical measurement of surface properties (often used by regional and national road administrations).

A simple system

A simple system could be based on annual visual inspections and systematic registrations of the actual conditions of the pavement in the road network. Digital photo and video systems for registration of pavement conditions are on their way. The simple system can in the future be based on results from automatic visual registration systems as soon as such systems are introduced. Different types of damage like potholes, ravelling, cracking etc. can lead to increased noise emission up to 3 dB. It will be necessary to develop a simple translation between the condition of a pavement (amount and severity of damage) on one side and the increased noise level on the other side. It is suggested, in relation to noise to operate with three classes of pavement conditions:

1. Good: + 0 dB
2. Acceptable: +1 dB
3. Unacceptable: +2 to 3 dB.

In the suggestion for an advanced system, the noise emission is measured directly on the whole road network by the use of the CPX trailer measurement system.

Pavement classes

It is also necessary to establish relations between the standard noise emissions from the different pavement types used in a municipality. It is suggested to subdivide pavements into five noise classes:

1. Very noisy (reference pavement +3 dB or more)
2. Noisy (reference pavement +1 to 2 dB
3. Normal (reference pavement)
4. Less noisy (reference pavement – 1 to 2 dB)
5. Noise reducing (reference pavement – 3 dB or more).

Management strategies

On the background of pavement noise classes and the pavement condition, the relative noise emission of all road sections in a municipal road network can be predicted easily and registered in the Pavement Management System. With such noise

information, maintenance strategies for noise can be developed:

- Over a time period of, for example, ten years there should not be pavements belonging to the very noisy pavement class on the road network at all.
- Over a time period of for example six years, the pavements on the roads in districts with multi-storey residential buildings should only belong to the noise re-ducing pavement types.
- Over a time period of, for example ten years, the pavements on the roads in districts with detached residential houses should only belong to the less noisy pavement types.
- In residential areas at spots with extra increase in the maximum noise level, the road surface shall be visually inspected in order to find the reason for this increase. The problems should be solved by repair work or other relevant action within two years.

Noise deterioration model

In order to make a strategic planning of noise reduction, it is necessary to develop a general model that can predict the increase in noise emissions over time for various pavement types. Such a model can be integrated in a PMS as a kind of "deterioration" model for the noise component in order to be able to "forecast" the noise emission over a time period of for example ten years or so.

Hans Bendtsen and Bjarne Schmidt, Danish Road Directorate, Danish Road Institute, Denmark.

For more information:
SILENCE home page: http://www.silence-ip.org/

Noise can be integrated as a factor together with traffic safety, driver comfort and durability when existing roads are maintained and when the pavements are being renewed.

Electrical Resistivity of Concrete

as a Durability Parameter for Concrete

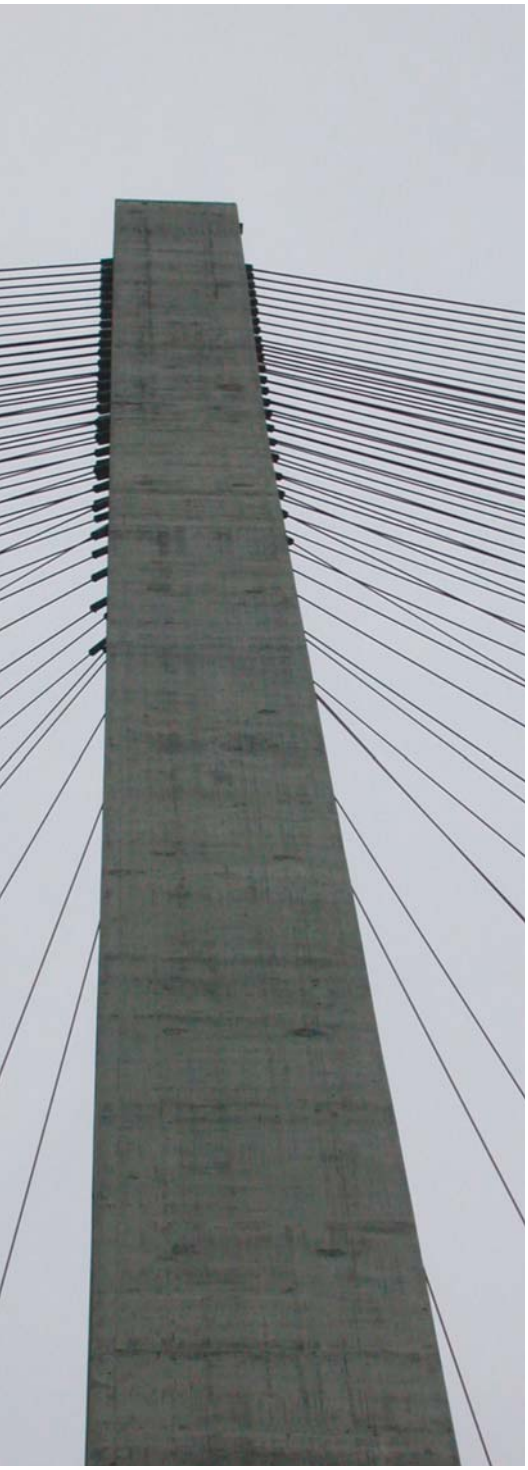


PHOTO: JAN-M. ØSTVIK

Electrical resistivity of concrete has gained more attention the last years due to its suitability for monitoring the durability of reinforced concrete structures.

During the last two decades several projects have been initiated by the Norwegian Public Roads Administration aiming to enhance the understanding of durability of marine concrete structures. Several parameters have been studied, such as chloride ingress, exposure conditions, concrete composition and blended cements. However, the last few years electrical resistivity of concrete has increasingly gained more attention due to very interesting results.

Our interest in the electrical resistivity of concrete is at least twofold:

1. Corrosion of steel reinforcement in concrete structures that are part of the coastal infrastructure is the major durability problem in Norway. The rate of corrosion above seawater is primarily determined by the concrete resistivity. It is consequently of inherent interest to know the overall bulk resistivity of concrete (which is readily accessible and measurable) and how it is affected by temperature and moisture state (degree of saturation, DS). Of particular interest is how resistivity develops over time in field conditions.
2. The resistivity can in principle be used as an indication of the moisture state in a structure. DS is regarded as particularly important since all deteriorating mechanisms are dependent on the moisture content. DS in concrete bridges has previously been determined by destructive sampling, but this is a very costly and cumbersome process. Monitoring resistivity is regarded as technically much easier and more reliable than relative humidity probes. The challenge is to interpret the resistivity data in terms of DS, since temperature, aging effects and chloride intrusion influences the measurements and must be compensated for.

The Technology department at the NPRA has recently published one Dr. Ing. thesis and several papers at international conferences dealing with measurements and interpretation of electrical resistivity data. Based on this research we do believe that we are able to compensate for temperature in our interpretations and to perform automated measurements. This enables a more reliable and less expensive monitoring of durability of existing and new concrete structures.

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Nordic Co-operation: Exchange of Civil Servants

For two weeks in May and two in September 2006, Synnøve A. Myren, an employee at The Department of Technology, Norwegian Public Roads Administration, NPRA, stayed for purpose of study at The Danish Road Institute, Materials Department. Every year Nordic Council of Ministers allocate money with the intension to increase the knowledge about central government administration, legislation etc. within the candidate's professions. It was in the light of this arrangement the study tours were realized.

The Materials Department at The Danish Road Institute had put together a versatile and exciting program for these four weeks. One of the topics was about the use of alternative materials, an area in which Denmark has made great stride.

– I got to learn about Denmark's history within the use of alternative materials, how the development has been since the regulations 1970s in connection with the use of these materials in addition to guided tours to several recovery plants, says Synnøve Myren, who has worked with heavy construction waste in Norway.

Additionally the educational trip also included field research – investigation of subsoil materials by means of mini drop weight and participation in inspection of concrete bridges. Also information about damp proofing of concrete bridges, concrete roads in Denmark, CEN work within the area of road materials and laboratory tests were part of the study program.

– I gained very much during the periods of study in Denmark, both with regards to my professional and my personal development. Another important result of the two stays was the establishment of connection between The Danish Road Institute and my work place back home in Norway. My contacts at The Danish Road Institute had prepared a really professional program to make my stay as useful as possible, and I'm very happy for the opportunity which was given to me. I want to challenge other civil servants to look into the possibility for participating in the program for exchange of civil servants in the Nordic countries, Synnøve Myren finally says.

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More information on the homepage of The Nordic Council of Ministers: www.norden.org.

Researchers Want to Wake up Tired Drivers

More than 20 per cent of all road accidents in Sweden are due to fatigue on the part of drivers. Driving while tired can be as dangerous as driving under the influence of alcohol or drugs. In spite of this, many drivers decide to drive when tired, and in this way put both their own and others' lives at risk. VTI is engaged in several projects which aim to reduce the number of fatigue-related accidents in traffic.

Sweden is often in the news for its initiatives and progress in traffic safety, but when it comes to fatigue-related traffic research, we are lagging behind. In countries such as the US, Australia and UK, high priority has for a long time been given to fatigue in traffic. In order to tackle this issue, VTI researchers have since 2000 been involved in several studies which deal in various ways with the problem posed by tired drivers.

Rumble strips at the edge of the road are effective

A road edge with milled rumble strips makes a car that has drifted to the side of the carriageway shake violently. This has been found effective in waking tired drivers. The number of run-off-the-road accidents to the right has been reduced by 50–60 per cent on sections where the method has been tested. Rumble strips along the edges of the road are now standard on all new motorway projects.

VTI is now researching into what happens when the strips are replaced by automatic vibrations in the vehicles. Such a system would not create noise for those living near the milled rumble strips, nor disturb cyclists who cycle along the side of the road. A system in the car which incorporates infrared light can sense when a certain line has been crossed and will warn the driver. The VTI studies have shown, however, that this technique must be improved since it does not work in snow or when the lines are worn.


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Instead of the above, what is best at sensing that the driving performance of a driver is impaired because of fatigue is a system that is not coupled to the road but notices changes in driving behaviour. These may be changes in how the car is being steered or where on the road it is placed. Indices based entirely on the driver are also used. In most cases these are contactless systems which measure, for instance, the blink rate. Blink rate is often a measure of the driver's level of drowsiness. The blinks of a drowsy driver last longer than those of an awake driver. For such a system to function satisfactorily, it is mainly the sensor technology that must be developed, and also the algorithms.

Emotionally loaded warning

In the beginning of 2006, the largest initiative ever concerning fatigue-related traffic research started in Sweden. The project is called DROWSI (Drowsiness Intervention) and is led by Volvo. What is unique about this project is that it extends over several disciplines and the problem can therefore be tackled from several directions; from fatigue research to the development of technical equipment in the vehicle, and issues concerning information and the dissemination of information. Other partners apart from VTI are the Swedish Road Administration, Autoliv, Chalmers University of Technology and IPM, Institute for Psychosocial Medicine. VTI's

If you feel tired while driving, sleeping for 10-15 minutes is enough to reduce your fatigue to a level such that it no longer poses a danger.

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task in the project is to develop effective warning strategies, and also to perform a large scale simulator study with the aim of collecting data for the development of algorithms. VTI is also participating in developing these.

Noise, light and vibrations in the seat belt or a device on the arm can be used to make a tired driver aware of his/her state. The difficulty is that the driver must be willing to do something about this.

– The best is an emotionally loaded warning, something that concerns the driver. It might be a recording of a little girl calling "Wake up daddy", says Anna Anund at VTI. Nothing is known about this at present, however, and it is hoped that DROWSI may make a contribution in this respect.

There are also plans for a warning system coupled to the car's navigation system. After the tired driver has been woken up and warned, the system could instruct him/her to take action that is geographically correct, such as "stop at the next rest area" if the car is nearing such an area.

In the hands of the driver

In legislation, fatigue in traffic is dealt with in the same section as drink driving. Driving while tired is just as unlawful as driving under the influence of alcohol.

– If you are very tired, your driving performance is reduced by the about the same amount as though you had a blood alcohol level of 0.08 per cent, says Anna Anund.

The problem is that the law is imprecise. For alcohol there is a certain maximum blood alcohol level, but there is nothing similar for fatigue. There could be a law for driving while tired that lays down the maximum number of waking hours, but there are no facilities for checking this in the same way as in the case of alcohol.

– What is needed is for a driver to recognise the feeling of fatigue, to be motivated to do something about it, to know what is the best thing to do, and to do it. But what is most important is not to get into a situation where it is dangerous to drive because one is tired.

Anna Anund wishes that there could be a more enforceable system, similar to the alcolock.

– In the ultimate it is at all times up to the driver to recognise the danger and do something about it.

The most important factor therefore in the work on fatigue is to inform and educate drivers. It is not until people themselves realise that it is dangerous to drive while tired that it will be possible to really do something about the problem. In this area also, Sweden is lagging behind many other countries.

What then is to be done when a driver knows that he/she is tired and is nevertheless obliged to drive somewhere? Measures such as to turn up the volume on the stereo or wind down the window to let in air may work for a while, but the problem can be solved only by stopping to have a sleep. In actual fact, sleeping for 10–15 minutes is enough to reduce your fatigue to a level such that it no longer poses a danger for either you yourself or for other road users.

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On the 31st of December 2005 the toll ring in Trondheim was shut down.

PHOTO: ERIK AMDAL, NPRA

Traffic Impacts from the Closing of Trondheim Toll Ring

The Trondheim toll ring was established in October 1991. After nearly 15 years of operation the toll ring was closed on the 31st of December 2005. An evaluation report has been carried out (NPRA 2006) in order to investigate the traffic impacts from the closing of Trondheim toll ring. This article summarises some of the findings in the report which shows that traffic has moved in time, but still the overall effect seems to be minor.

The Trondheim toll ring was established and put into operation on the 1st of October 1991, more than one year delayed according to the original plans. Despite the delay and a 15 years estimated time of operation, the toll ring was removed 31st of December 2005. The Trondheim toll ring, together with the toll rings in Oslo and Bergen, was the first of its kind in Norway. Both the toll rings in Oslo and Bergen started before Trondheim, but instead of closing they have chosen extension in order to finance new roads rather than shutting down. Trondheim has by its closing the toll ring, the first toll ring in Norway that has been shut down. To study the traffic impacts from closing of an urban toll ring is therefore important in order to gain new experiences.

The tolling scheme in Trondheim has been undertaken two major revisions; first in 1998 were the number of charging points where increased from 11 to 18 and second in 2003 where 6 more charging points were established. During that period of time the toll fee increased from 12 NOK to 15 NOK. The operational period was Monday to Friday from 06:00 a.m. until 06:00 p.m.

In this analysis the traffic was counted in

every toll station in the before and after situation over a period of four months. The results from the study show an increase in traffic volume of 9.6 per cent during the hours of operation of the toll ring. Outside the period of payment the traffic shows a decrease of 0.9 per cent. For a 24-hour period the traffic increase is about 5.5 per cent. At the same time the general traffic growth in the county of Southern Troendelag has been some 5.2 per cent. The real traffic impacts of closing of the toll ring seem therefore to be minor as looking over the whole period of a day. However, some areas in Trondheim have got a substantial increase in traffic volume during the period of the opening hours of the toll ring. We find an increase in traffic of 10 to 11 per cent, which clearly shows that traffic has moved in time from outside the period of payment to within. Earlier studies (Meland 1994) show that when introducing of the Trondheim toll ring the total traffic during a week were unaffected, but a decrease could be seen within the period of payment. It is interesting to see that this effect now works in the opposite direction.

By looking more into the data we clearly see that the traffic increase are declining over time, which is somehow strange according to empirical studies on price elasticity. Adapting these results into a study of elasticity may therefore be of interest. The data also shows that the biggest traffic increase is between 05:00 p.m. and 06:00 p.m. A possible explanation for such a result is that the users are more flexible in the afternoon, contrary to the morning where fixed appointments often are required.

Summarised we can say that the closing of Trondheim toll ring did have the following short term effects:

- The real traffic growth for a 24-hour period is almost nothing, but....
- The traffic has moved in time. From outside of the period of payment to within. A few areas have got a substantial increase in traffic during the opening hours of the toll ring.
- Traffic to the inner city has almost no change at all. Other conditions, such as the possibility of getting a parking lot, seem to be more important than paying the toll fee.
- As a financial instrument the toll ring seems to have been a success. The toll ring has got low operational costs, few motorists didn't pay and the traffic deterrence was low.

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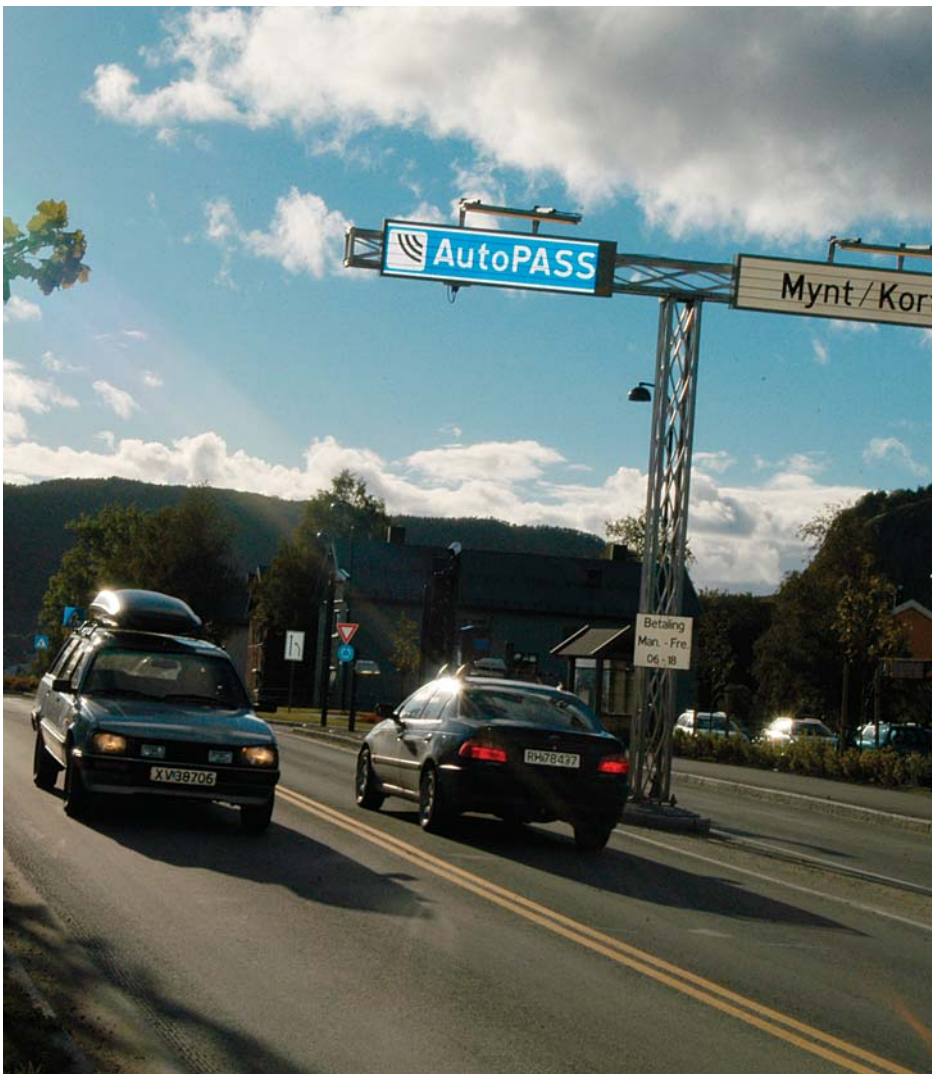


PHOTO: KNUT OPEIDE, VEGVEN OG VI

Illustrated photo from an AutoPass Charging Point.

Towards Realistic Assessment of Fuel Consumption and Emissions from Heavy-Duty Vehicles

Heavy vehicles account for a large share of road traffic and transport-related exhaust emissions as well as fuel use. Thus, progressively tightening legislative measures have been launched worldwide, aimed at pushing manufacturers to develop more effective emission control. Recent implementation of EURO4 regulations and subsequent introduction of new low-emission engines clearly shows success in this effort. However, there are still apparent pitfalls in this system regarding the assessment of real-world performance of these vehicles.

The present testing for heavy-duty vehicle type approvals deals with the engine only. The weaknesses of this method are twofold: Firstly, when legislation and limit values are based on specific emissions, relatively little is known of real on-road emissions in relation to kilometres driven and tonnes of goods transported.

Secondly, reporting of fuel consumption is not included, even if fuel costs keep rising and reductions in CO_2 emissions are called for. Additionally, engine-only testing can deal only with a subset of factors affecting the emissions and energy use. Important features of the vehicle itself, as well as all operational parameters, are not assessed.

Test facility at VTT

VTT has purposefully developed methods and acquired equipment for assessment of real-world energy use and emissions output of trucks and busses. The aim has been to assess the in-use performance of a complete heavy vehicle in order to produce realistic and comparable data for comparisons of the environmental features of vehicles.

VTT's facility houses a full-size chassis dynamometer with rollers 2.5 m in diameter, large enough to bring the tyre-to-roller contact close to conditions on a normal level road surface. The chassis dyno enables duplication of on-the-road driving, including simulation of air drag and rolling resistance, as well as modulation for driving uphill or downhill.

Adding the uphill/downhill gradient is especially important when testing heavy trucks, as their engine loading is drastically dependent on the road gradient, even if the vehicle speed remains almost constant through cruise control activation.

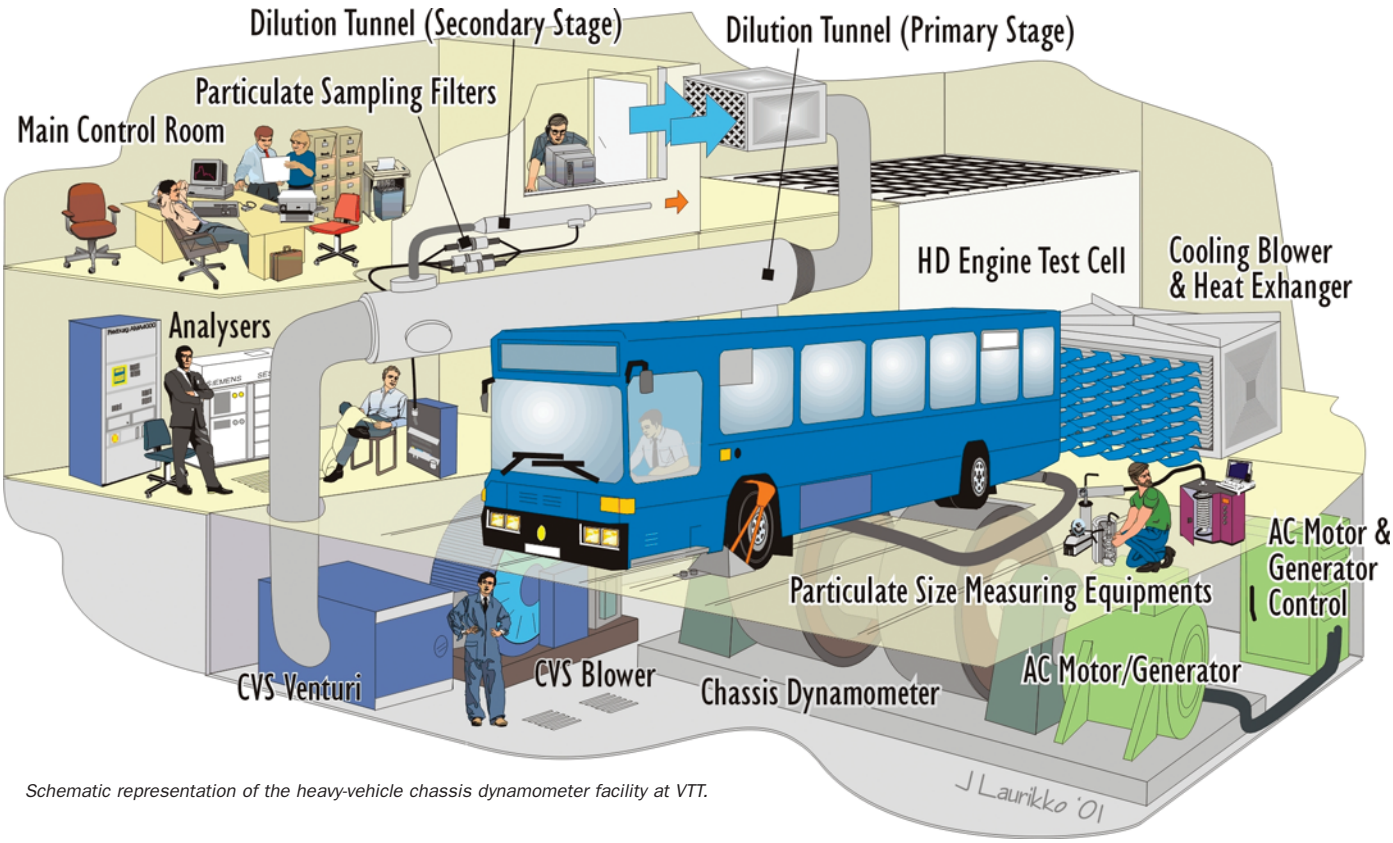
The rig allows full inertia simulation up to the largest allowable gross vehicle weight for road vehicles in Finland and Sweden, currently 60 tonnes. The continuous maximum power absorption is 300 kW at the driving wheels, which equals about 500 horsepower at the engine.

The distinct difference that using a duty-cycle closer to real-world application of the vehicle brings to the assessment of performance can be seen in the diagram. It plots the present-day certification cycle (ETC) and a widely-known real-world duty cycle applicable for urban bus driving (Braunschweig) on the operating map of a bus engine. The difference between the allocations of the second-by-second operating points of both cycles is quite distinct. Hence, one can expect the fuel consumption and emissions also to be very different, because specific fuel consumption (depicted in the figure), as well as emissions, are quite different from one regime to another.

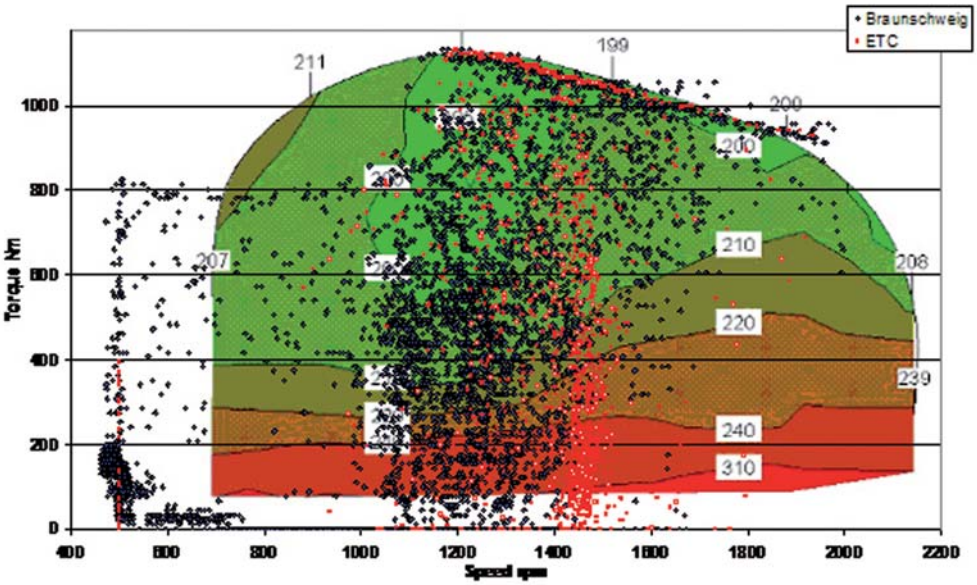
Seeking fuel savings – what can be achieved?

The facility and methods described above have been successfully employed in a multi-year initiative, targeted towards real-world reduction of fuel consumption of heavy vehicles, and seeking permanent fuel savings of the order of 5 to 10 per cent by a multitude of factors, such as:

- Choosing the right vehicle for different types of applications and subsequent duty cycles



Schematic representation of the heavy-vehicle chassis dynamometer facility at VTT.



Plot of the operational points of the present-day European certification cycle (ETC) and a duty-cycle applicable to real-world operation of an urban bus (Braunschweig).

- Employing technical improvements to the design of the vehicle and its components
- Optimising the driving of vehicles by utilising various information systems (drivers' aids).

The aggregate of results of this research effort shows the potential of various fuel-saving measures. The extent to which these factors can achieve reductions in energy use were as follows: Various technical measures, like weight and aerodynamics of the vehicle, up to 30 per cent; driver guidance through technical aids 5–15 per cent; choosing the make of vehicle 5–15 per cent; choosing between tires 5–15 per cent; using air deflectors and other aerodynamic aids 4–8 per cent; choosing the type of trailer 3–5 per cent, and choice of lubricants 1–2 per cent.

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ESTHTABLISHING COMMON GROUNDS FOR MORE REALISTIC ASSESSMENTS

VTT and several other European research institutions have formed an Action Group (AG), 'Environmental performance indicators for heavy duty vehicles', operating under the European co-operative framework ERA-NET . The main objectives of the work are to exchange experience among institutions that perform testing of complete large vehicles, and to establish a common framework for assessment of fuel economy and environmental performance of heavy vehicles. This framework could help public parties in their efforts to support low-polluting and energy efficient vehicles, as well as private operators in their vehicle purchasing decisions. Updates of the work in progress can be found on the website2.

[1] http://www.transport-era.net/neu/

[2] http://www.transport-era.net/neu/index.php?id=164

School transport from the children's perspective

Title: Children's perspective on safety and security in school transportation
Series: R548
Authors: Anna Anund and Jonna Nyberg
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About 440,000 Swedish schoolchildren travel by school bus to and from school every day. Of these, several thousand have some form of functional impairment. The requirements which school transport has to comply with are regulated by a number of laws and decrees, but none of these consider the children's perspective. In a study performed by VTI, based on field observations, interviews and focus groups comprising children, their parents and school transport drivers, an attempt has been made to capture the children's perpective.

The results show that many children, especially those who have functional impairment, experience stress and worry about the school transport situation. The worry is associated with the attitude of the driver and with their situation as passengers inside the vehicle. Overcrowding, an unruly atmosphere, travel sickness, group pressure and lack of safety routines constitute the everyday experience of children in school transport. They worry about what the journey is going to be like, if they will be put down at the right place, if they will have a good seat and get help in putting on their seat belt, and so on.


PHOTO: ÖSTGÖTATRAFIKEN

Among the children interviewed who have been involved in accidents, accidents due to hurrying were common, and pressure of time is a serious cause of the worry and stress experienced by children in school transport. Children also emphasised the critical role which the bus driver has; clarity and a positive attitude have a great effect in making school transport safe.

School transport must be safe and accessible, and all schoolchildren, whether or not they have functional impairment, must feel secure in it. The study proposes several improvements. Some of these are

- Train children in a spirit such that they understand why certain measures have been taken, but without expecting that these will ensure that children can at all times observe a certain rule.
- Introduce designated seats to minimise overcrowding and to ensure that children will sit still during the journey.
- Introduce strict, clear and simple routines so that children will know what is going to happen; for instance, children can be assured via pictures or spoken messages that the driver knows they must get off and where they must get off.
- Train transport firms and assistants how to help children with functional impairment get on and off the bus, and how to secure both disabled aids and the children.
- Inspect stops with regard to safety and security aspects.

A start must also be made on applying a "whole-journey" perspective to school transport. For instance, the route the child must take to and from the school transport stop must not be forgotten. For some children this is heavily trafficked and a clear danger. Who is responsible for what must also be clarified; when and where during the journey to school the responsibility of the parents ends, and when and where the responsibility of the bus driver and the school begins.

Seminar on Road Noise Abatement

Title: Seminar on Road Noise Abatement
Authors: Hans Bendtsen, Carsten Bredahl Nielsen, Helen Hasz-Singh
Series: Technical note 37 (http://www.vejdirektoratet.dk/publikationer/VInot037/index.htm)
Language: English

The Danish Road Directorate, Danish Road Institute has made a co-operation agreement with DWW (Dienst Weg- en Waterbouwkunde, the Netherlands) to carry out research in noise reducing road pavements under the name of the DRI/DWW Noise Abatement Program.

In connection with this co-operation, a seminar was held in Denmark on 8–9 June 2006 for invited Dutch and Danish representatives from the road and environmental authorities. The purpose of the seminar was to collect a number of senior researchers from the road sector and government officials from both countries to discuss themes on road traffic noise. The seminar should form the basis for a following seminar for decision makers (ministries, EU, etc).


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Phasing out old heavy duty vehicles

Title: Emission charges in a low emission zone
Authors: Arild Skedsmo and Rolf Hagman
TØI report no: 848/2006
Available on www.toi.no

Due to technical improvements, phasing out all old heavy duty vehicles in exchange for the latest models is expected to reduce the present emission of NO_x and PM10

from heavy duty traffic in Norwegian cities by approximately 80 per cent. This emission reduction will be achieved around 2020 through "natural" phasing out of old vehicles. A more rapid phasing out can be stimulated by introducing a low emission zone (LEZ) where emission charges are levied on older vehicles. Emission charges reflecting the calculated value of health effects from tailpipe emissions would reduce the phasing out time by 4–5 years. By assuming a politically set target for emission reductions, charges could be set to stimulate 80 per cent reduction in emissions from heavy duty vehicles immediately following the implementation of the LEZ. A cost-benefit analysis showed that none of the charge regimes would give a social surplus.

Smart help when accident occurs

Title: Impacts of an automatic emergency call system on accident consequences.
Author: Niina Sihvola
Series: Ministry of Transport and Communications, AINO publications 14/2005 (http://www.aino.info/julkaisut/4_kuljtuki/aino14_2005.pdf)
Language: Finnish with English abstract.
English summary report available on http://www.ecall.fi/eCall_Safety_Effects_Finland_Summary_final_06.pdf

According to the goal set in 2001 by the Council of State of Finland, the number of traffic fatalities annually should be under 250 by the year 2010. This goal calls for a reduction of at least 125 traffic fatalities from the number in 2004. The pan-European emergency call system (eCall) developed on the initiative of the eSafety Forum composed of the European commission, industry and other traffic safety stakeholders is believed to help in meeting this goal. The aim is to have eCall as standard option in all new type-approved vehicles from September 2010.

The eCall system is based on either the automatic detection of an accident with an instrument or a manual emergency call made by pushing a button. In both cases a normal voice communication is opened to

the emergency centre after a small delay, and accident vehicle location and identification as well as possible accident severity information is transmitted automatically. The automatic detection of an accident is based on the vehicle's sensors or the sensors built into the eCall device.

The aim of the study was to estimate the impacts of the eCall system on accident consequences in Finland. More specifically, the study estimated the annual number of fatalities that could be avoided using the eCall system, the effects of eCall on emergency response times, and the effects of real-time information about the vehicle location and accident type on the consequences of the accident.

The estimated number of fatalities that could be avoided using the eCall system is based on the case reports of Road Accident Investigation Teams covering the period 2001–2003.

The results showed that the eCall system could very probably have prevented 4.7 per cent of the fatalities in accidents involving motor-vehicle occupants. In the accidents involving a fatally unprotected road user, however, the system could probably have prevented no fatality. In all, the eCall system was estimated to be able to reduce 4–8 per cent of road fatalities in Finland.

Based on the main findings of this study, the eCall system is recommended for immediate and widespread implementation in Finland. The study also indicated a need for developing statistics on severely injured accident casualties.

Roundabouts are safer

Title: Junction design – a review
Authors: Anna Vadeby and Ulf Brüde
Series: R554
Contact: Anna Vadeby, anna.vadeby@vti.se
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A large proportion of road accidents occur at junctions. More than 20 per cent of the people who are injured on rural roads in Sweden are injured at junctions. 15–20 per cent of fatal accidents occur at rural junctions. The corresponding figures for urban areas are about 60 per cent and 45–50 per cent respectively. Junctions pose a great risk of injury to drivers, cyclists as well as to pedestrians. Therefore, it is good reason to improve road safety in and around junctions.

Examples of the measures taken to reduce the number of accidents and accident severity around junctions are turning lanes, better lighting, stop signs, and especially speed calming measures. However, the predominant measure has been to convert junctions into roundabouts. This has been found to be a cost effective measure

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that reduces accident risk, injury risk and accident cost. The positive effect of such a change depends on how many accidents that occurred at the junction in its original layout, but several studies indicate a reduction in injury accidents by 70–80 per cent, and a reduction in accident costs by up to 90 per cent.

A study of the literature which VTI has carried out shows that there has not been a lot of progress in recent years as regards

safer design of road junctions. The knowledge in the Nordic countries is mainly based on studies made in the 1980s and 1990s. One example of the area where there is a lack of knowledge is the way in which the actual roundabout, or the central island, should be designed to make it as safe as possible. For example, how does the road furniture on the central island affect sight conditions for drivers? And how are accident and injury risks affected by the design of the central island and the road furniture on it? Even more important for future research is to investigate how safe roundabouts are for cyclists. For drivers, roundabouts are much safer than traditional junctions and for pedestrians they appear to be as safe or unsafe as other types of junctions. However, as far as cyclists are concerned, factors such as inappropriate design and excessive speeds may have the effect that safety is actually reduced after a junction has been converted into a roundabout.

Optimal public transport subsidies

Title: Optimal subsidies for Norwegian urban public transport
Authors: Jon-Terje Bekken and Bård Norheim
TØI report no: 829/2006
Available on www.toi.no

Based on the analytical framework developed in the ALTFIN project (Alternative urban transport funding) and the recent EU project REVENUE (Revenue use from transport pricing), we have analysed the use of incentives in six Norwegian urban areas and the importance of the rail service in the Oslo region. The report outlines an optimised incentive mechanism of NOK 150 million annually for the six urban areas, giving a net social benefit of NOK 900 million per year. A transfer of funds between the railway and other modes provide only moderate gains.

Testing service for the electronic waybill

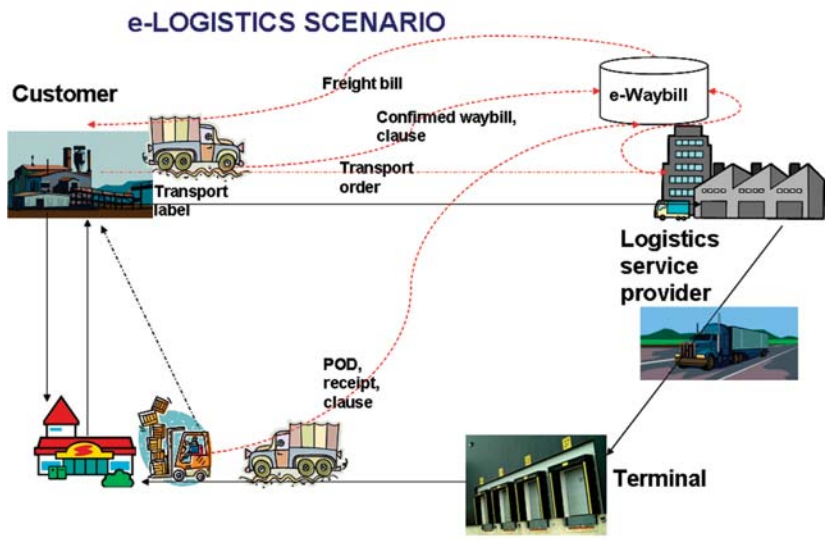
Title: KULTIS – Electronic Transport Information. Testing Service for Electronic Waybill
Authors: Jari Salo, TIEKE, Juha Ikävalko, TIEKE, Kim Hacklin, TIEKE, Jani Granqvist, VTT, jani.granqvist@vtt.fi
Series: AINO publications 32/2006
Language: Finnish with english abstract
Available on http://www.aino.info/julkaisut/2_kul-jinfo/aino32_2006.pdf

It has long been accepted that there is a need to digitise the goods transport information relayed between players within the transport chain. The objective is to reduce the number of documents that need to be moved around and to standardise the document templates used by different players for the same purposes and, whenever possible, to digitise their processing and relaying procedures.

The creation of an electronic waybill is a significant step towards automated systems. The digital transmission of waybills is already an everyday occurrence for large transport companies, who transmit a great deal of their goods transport information digitally as EDIFACT messages. The digitising of goods transport information allows for better transport chain planning, operating and management, and thus improves the efficiency of transport operations. Trade, industry and the transport sector all benefit.

The aim of this Finnish project was to set up a testing service for the electronic waybill, while simultaneously verifying the electronic waybill data content description drawn up during the earlier definition project, both in practice and in a real operating environment. The interfaces of other data flows associated with the transport event were also examined in relation to the waybill.

The electronic waybill testing service allows software houses and various processors of electronic waybills to test the correctness of the data content of the electronic waybill during the transmission and reception stages. The service also allows checking of the correctness of conversions between different waybill file formats and the printing out of sample documents. It will make testing easier and faster and will reduce the number of problems faced by end users.



How an urban consolidation centre can be introduced

Title: Implementation of SAMLIC – the Proposal and the Process
Authors: Jan Eriksson, Bertil Lundgren and Tomas Svensson
Series: R528
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Congestion and waiting times are increasing in Swedish traffic, not least in the vicinity of the many loading bays in cities. This increases the costs for the distribution of goods and also results in unnecessary exhaust emissions. Urban transhipment centre is one way in which these negative consequences can be reduced.

Since 2003, the project SAMLIC, an endeavour to design an economically and logistically efficient coordinated distribution system for the city of Linköping, Sweden, has been in progress at Swedish National Road and Transport Research Institute, VTI. A pilot test showed that the number of vehicles needed decreased by 25–35 per cent, the total time for distribution by 20 per cent, and the total driving-time in the city centre by over 50 per cent. Even when the costs of introduction and operation in the form of staff, administration and similar are included, there is a net cost saving at firm level of about 10–20 per cent. When the scheme is extended in the future and if the relevant social costs are included, the savings will be substantially higher.

The latest contribution from SAMLIC is a comprehensive proposal for the way in which a similar coordinated distribution system could be introduced in other cities. This proposal may act as a decision base for future negotiations prior to such introductions. It contains a number of components which must be included and also a draft for the necessary contractual agreements. But, most of all, it shows the process underlying the SAMLIC proposal and the pilot test. Even though the concept for coordinated distribution is the same for all cities and is clearly set out for transport firms, there is scope for alterations to suit local conditions. The documented process can therefore be of great help when the next scheme for coordinated distribution is considered.

Alcolocks in public busses

Title: Alcolocks in public busses
Authors: Terje Assum and Rolf Hagman
TØI report no: 842/2006
Available on www.toi.no

A trial with alcolocks in public buses has been carried out in Lillehammer, Norway, in order to show to what degree the drivers would accept driving with alcolocks in busses and how the alcolocks would function technically and practically. After a visit to a Swedish bus company that had used alcolocks for 2–3 years, and after using the alcolocks during the trial, the majority of the drivers accepted the alcolocks. The alcolocks worked well during the trial, and caused no delays. No proven case of drunk driving or positive test without approved retest was detected.


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